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CONFIDENTIAL

GLANDERS

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CHAPTER ONE

HISTORICAL DATA

EVOLUTION OF THE THEORY OF GLANDERS

The first mention of glanders as a specific horse disease is lost in deep antiquity.

Aristotle (330 BC), the father of universal science in ancient Greece, had already in his time defined glanders as a malignant contagious disease by using the word μηλις which means bad disease, epidemic. [illegible]

Apsyrtus (IV century) and Vegetius Renatus (V centruy) also considered glanders an infectious disease. The latter, having phonetically reconstructed the above quoted Greek term, as used by Aristotle, into Latin, coined the universal name designating glanders as "Malleus" or "Malleus humidus", a name retained to this very day in the modern romance languages, as "Morve" in French, "Morvo" in Italian.

Subsequently, the Latin form "Malleus humidus" became "Malleus humidus farciminosus", with an alternate designation of the disease, as follows: "Farcin" in French, "Farcino" in Italian, "Farcy" in English.

The Germanic tribes had two designations: "Rotz", meaning the glanders of the mucous membranes and the respiratory tract, and "Wurm", meaning glanders of the skin. These two forms were considered as different diseases.

After the V century there is a great gap, and no data on glanders

is to be found for a long time. Bass, [who in 1893 published the results of his research], steps across from the V century directly into the XVII century. In 1682, Solleysel maintained that glanders can be contracted through direct and indirect contact, and through the air:

"This disease is contracted easier than any other disease, since it will strike not only the horses finding themselves near one already diseased, but through the very air, which becomes polluted, all the horses under one roof may be affected." However, Solleysel did not segregate glanders into a separate disease, identifying it with chronic strangles, and as to the interrelation of the two kinds of glanders (respiratory and skin), he thought that "the lichen, or skin glanders is a cousin to [respiratory] glanders."

In the beginning of the XVIII century (1734), Caspard de Saunier established in detail the causes for the spreading of glanders. He points to the harness, blankets, cribs, gratings, ceilings, floors, feed boxes, as the basic communication routes of the disease, and speaks of the necessity for the sterilization of the above. Carsault, in 1741, insists on the destruction of horses infected with glanders, and the quarantining of horses showing suspicious symptoms.

Of particular importance in proving glanders an infectious disease was the work by Viborg, published in 1797, in which he maintained that glanders originates with a contagious toxin of, as yet, unknown characteristics. The disease spreads [through the body] by way of the contagium carried with the pus, as a result of which pussy ulcerations are formed on the mucous membranes, or lesions formed in the lungs. A subcutaneous inoculation with glanders exudate will result in glanders of the skin. Contamination may also occur by inhaling the secretions of an infected horse, by way of contaminated saddles, harnesses, and, particularly, by way of left-over fodder and straw in the crib that has been

occupied by an infected horse. Viborg already furnishes certain indications as to the characteristics of the contagium, although at that time it was, as yet, unknown.

The glanders virus is destroyed with desiccation and with heating up to 64-66 degrees Centigrade. Viborg therefore recommends that the stables be disinfected with hot water. He also maintained, that glanders may be present in dangerous hidden phases, wherefrom came his recommendation, that horses just recovered from skin glanders should not be shifted to the general stables for a period of at least 6 months. Viborg conducted experimental studies of the evolution of glanders, and was aware of the lung, nose, and skin varieties of the disease. To facilitate diagnosis in difficult cases he recommends the contamination of the horse. He was not successful in infecting other animals.

Thus, the theory of glanders as a contagious disease was strengthened, and finally became so widely accepted, that in France, as early as 1753 and 1784, this fact was confirmed by decrees of the Royal Council.

In Russia glanders was looked upon as an infectious disease as early as the first half of the XVIII century. In 1737, in the Pakhrinsk stables - "under the cheeks of two stallions appeared a disease called lichen" The stallions were assigned to a horse doctor for curing, but, "due to his negligence, or rather ignorance, the said stallions from the said disease developed glanders." Another horse doctor, named Petr Bove, considering the disease extremely dangerous, "lest from the said stricken stallions to the other (of the same stable) horses be incurred some damages", proposed that the affected horses "for the above described danger be shot" (Novombergskiy). This shows, that Petr Bove knew of the disease of glanders striking at the ~~submaxillary ganglia~~ cervical lymph glands and the nasal area, and also of the contagiousness of this disease.

Parallel with this, the theory of the non-contagiousness of glanders was developed. This viewpoint was first expressed in 1749 by Lafosse the Elder. He considered glanders as a localized disease of an inflam-

matory nature, but not infectious. The Lafosse opinion was criticized sharply by Burgelat and by the representatives of the Lyons and Alfort veterinary schools. Subsequently, the Alfort school reversed its opinion about the infectious origin of glanders, and, with the beginning of the XIX century, it was strongly supporting the opinion of the spontaneous generation origin of glanders. This, resulting in relaxed vigilance, undoubtedly contributed to the spreading of glanders in France and, partly, in other European countries.

This opinion was championed first by Godine in 1815, after obtaining a negative result from vaccinating a healthy horse with nasal secretions from an infected horse. Dupuy, in 1829, supported the opinion about the spontaneous origin of chronic glanders. As to the acute form of glanders, he maintained, that he was obtaining positive reactions by inoculating healthy horses with it. He recommends, for all practical purposes, to take measures "as if glanders were infectious, even though it has been proven that it is not."

About the same time (in the 1830's) the theory of the spontaneous origin of glanders is reinforced by the Alfort [veterinary school], with the support of the following scientists: Brussais, Renault, Delafond, and Buley. In Germany the same opinion was defended by Hering and Bruckniuller, and in Italy by Ercolani.

Renault advanced a theory, that the appearance of glanders lesions is due to the absorption of pus from a chronic nucleus. Buley supplemented this with his theory of "organism emaciation", caused by poor maintenance conditions and overexertion.

The results of the above theoretical discussion soon became apparent. The veterinaries of the French Army, almost to a man, followers of the Alfort school, were promoting the viewpoint of their teachers. Measures to combat glanders were either completely abandoned, or were

deficient, and "hundreds of glanders-infected horses rejected by the Army as incurable, spread the disease in the villages. Wherever horses were gathered, particularly at mail depots, every tenth horse of the available herd was stricken with the disease (Nokar and Leklench).

During the decade 1830-1840, the epidemic of glanders attained particular proportions in France.

In 1836, the Minister of War in France appointed a commission for the purpose of studying the contagiousness of chronic glanders. The commission in its extensive work obtained definite proof on the infectious character of glanders, yet "such was at this time the power of established opinions, that they refused to ascribe to the facts their indubitable meaning." (Nokar). Thus, the commission did not report any conclusion as to the infectious characteristics of glanders.

The Lyons Veterinary School continued to defend the postulate confirming the infectious origin of glanders. Rainard wrote in 1825: "Glanders may be communicated to a horse sharing quarters with an infected animal, or even by merely finding itself in contaiminated places." This opinion was shared by Hausmann in Germany, Perciwall in England, Volpi in Italy.

Following Rainard, another representative of the Lyons Veterinary School, Urbain Leblanc continued to defend the theory of the infectious origin of glanders.

In 1837 occurred a case, which attracted the attention not only of veterinary specialists and physicians, but of the entire public. The famous physician Rayer ascertained a case, where a man was infected with glanders by a horse, and, in turn, communicated the disease to another horse. In 1839 Leblanc published a report relating to "experimental research on the effects of glanders and lichen vaccination," proving the infectious origin of glanders.

Brechet and Rayet (1840), in summarizing the results of scientific research, wrote: "Glanders can be communicated to man and animals, such as dogs, female goats, sheep. Glanders can be carried from humans to horses and asses by vaccinating them with the secretions from a glanders lesion ... The degree of facility, with which animals respond to the contagion, varies with type of animal. Of the whole-hoofed animals, an ass responds with more facility to the contagion and develops it to full intensity more rapidly than a horse."

Experiments by Saint Cyr in 1863 and by Gerlach in 1868 again confirm the infectious origin of chronic glanders. In addition, the latter furnished an adequate description of clinical [procedure].

At its inception, veterinary science in Russia was under the strong influence of foreign scientists, and, therefore, reflected opinions predominant in the West. In the medical handbook by the archiater [Chief Physician to the Empress] and Member of the [Imperial] Academy, Iogann Fisher, published in 1775, the following sentence is found: "Glanders is the same as strangles." In 1817, the Rector of the Department of Zootomy at the Academy of Medicine and Surgery, V. Vsevolodov, translated the "Abridged Pathology" by Tolnay, Professor of "Cattle-Healing Science" at the University of Pest. Professor Tolnay believes that glanders derives from strangles "driven inward." Since Vsevolodov makes no comments, he must be in agreement with this idea. The above concept had taken such hold in Russia, that later on we read about "strangles, from which glanders can be easily derived" in no less important a place, as "Regulations and measures abstracted from law summaries relating to the stopping of cattle plagues." (Novombergskiy).

In 1881, Babes succeeded for the first time in isolating the glanders-producing organisms in microscopic sections of tissues and in the pus taken from the glanders ulcer of a human. These organisms appeared as thin small sticks [rod-shaped bacteria]. Rozhaked'i observed

the same in the pus from a pustule of a glanders-stricken man.

In France, in 1882, Buchard, Capitaux and Charrin simultaneously succeeded in obtaining glanders bacterial cultures. They isolated the microbes from the walls of nasal ulcers, from ganglia in the lungs, and from the spleen of a stricken horse. The fifth reproduction of such a bacterial culture was used to contaminate an ass, which developed an acute case of glanders. The above scientists did not, however, succeed in obtaining a pure culture of glanders, such as was obtained by the German investigators Löffler and Schütz the same year. In 1886, in his second thesis on the etiology of glanders, Löffler furnishes complete data relating to the methods of coloring the glanders microbe, its cultivation in various media, and its stability in the presence of various reagents. Its pathogeneity with relation to various types of animals is also made clear.

Important research into the understanding of glanders and the countermeasures required, was conducted in 1889-1891. Gelman in Peterbury and Kal'ning in Derpt, independently of each other, made a compound from glanders microbes, which they called mallein. In studying this compound, investigators in various countries, such as Roux and Nocard in France; Preusse, Kitt and Foth in Germany; Schindelka, Schnürer in Austria; Babes in Roumania; Vladimirov and Matveyev in Russia, established the diagnostic value of mallein and the conditions of its application. At the same time, Nocard, Gutira, Schutz, Missner, Vladimirov, and others studied the pathogenesis, the propagation routes of glanders, and the biological characteristics of mallein.

The study of the serological methods of glanders diagnostics began in 1900. Vladimirov, Afanas'yev, Schütz, Missner, and others, first came forward with the agglutination test, which subsequently came into use around 1905. The following test, the so-called precipitation

test, was of no practical value. The complement fixation test (CFT) as applied to glanders was developed by Schütz and Schubert in 1907. In Russia the research work on the complement fixation test was done by Zhirnov, Fedders, and Dedyulin. It's wide use, as the official test for the diagnosis of glanders, is due to the labors of Ruzhentsev. The subsequent study of the test and the final formulation of the methods involved were done by Tsvetkov.

During and after the period of World War I (1914-1918) the pathologic histology in cases of glanders was studied by Ball, Bel', Cheruyak, Belkin, and Ivanov - in the USSR, and by Eberbeck in Germany. The outline of measures designed to combat the ravages of glanders was finalized in the USSR by Ruzhentsev, Vishelenskiy, Tsvetkov, and others.

GENERAL DATA

THE PROPOGATION OF GLANDERS

With the expansion of the study of glanders it became known, that from times immemorial the disease of glanders was present in various parts of the earth, yet it was not evenly spread. According to statistical data, partly, for the XVIII century, but mainly for the end of the XIX and the beginning of the XX century, the greatest number of horses stricken with glanders was observed in Europe and Asia, between the 40 and 50 parallel North, and in areas near these latitudes.

The following countries were particularly hard hit: France, Austria, Italy, the Balkan States, Turkey, the States of Central Asia, China, and Japan. North Africa and some of the islands of the Indian Archipelago came in for their share. The island of Java, beginning with 1854, registered frequent occurrences of the disease.

In the US there is no exact [overall] data on glanders, but some states (such as Massachusetts) report 364 horses stricken in 1896, 485 in 1897, and 848 in 1900. In these locations glanders was well

known, particularly, a considerable number of cases with chronic characteristics, while in the more northerly latitudes in Europe the number of cases was smaller, but the run of the disease was acute.

It seems, that up to a very recent date, the disease attained its greatest proportions in Asia. It was here, in Japan, that a certain variety of the glanders microbe, possessing mobility and other serological properties than the typical stem-shape, was isolated. In China and in India a microbe was discovered closely resembling the original variety of the glanders microbe - B. Whitmori (B. pseudomallei), which causes epizoa in rats and epidemics in humans.

During the Napoleonic and Revolutionary wars, at the beginning of the XIX century there was a considerable propagation of glanders in France. From 1830 to 1840 the unopposed spreading of glanders in France and in other European countries was due mainly to the then prevailing theory of its non-pathogenic origin.

The annual destruction of glanders-stricken horses in France amounted to 5.1 percent of the total Army horse contingent.

At the turn of the XIX century, beginning with the 1850's, the attitude towards glanders in most of the European countries registers a change. The theory of the spontaneous generation origin of glanders began to lose its defenders, and counter-measures against the spread of the disease began to take form. However, it was not before the beginning of the 1880's, when the organism causing the disease was discovered, that real counter-measures came into play.

In order to prevent the further propagation of the disease, and to facilitate diagnosis, a law forcing the destruction of all glanders-strucken horses, and the quarantining of all horses showing suspicious symptoms, was promulgated in France in 1882. Similar laws were put in effect, as follows: Germany and Austria - in 1880, Roumania and Belgium

in 1883, Russia - in 1884, Hungary - in 1888, Great Britain, the Netherlands, Italy, Denmark, Bulgaria - in the period 1892-1901.

Towards the year 1890, the number of stricken animals showed a gradual decline. However, during the 1890's the number of stricken horses, destroyed as per the above laws, was again on the increase; since, with the advent of mallein, there was more precision in the diagnosis. Towards the beginning of World War I (1914) there was a gradual decline in the number of cases, but during the war the armies of the belligerent powers as well as their civilian contingents, again registered a considerable increase in the numbers of horses stricken with glanders.

By the year 1930, due to drastic counter-measures, the number of horses stricken with glanders was curtailed sharply, and by 1940, in many of the states of Northern and Central Europe the epidemic of glanders was liquidated completely.

GLANDERS ABROAD FOR THE LAST 30 YEARS

Throughout the territory of France during World War I, from 1914 to 1918, there were registered as stricken with glanders and as showing suspicious symptoms - a total of 79,722 horses. Out of this total number, 20,897 horses were destroyed. In 1926 the number of horses stricken amounted to 0.04 percent of World War I total; in 1927, 0.17 percent of same total. As of 1 January 1938 there was only one case of glanders in the entire European part of France, while Algeria had 12 stricken horses in 7 different localities.

In Austria, in 1919 - 115 cases; in 1920 - 50 cases; in 1921 - 40 cases; in 1938 - none.

In Germany, during World War I there were registered 35,928 cases. In 1921 and in 1922 the Army destroyed 0.28 percent and 0.07 percent, respectively, of the above number. In 1938 Germany was completely free of glanders.

England had 15 cases registered in 1920. Italy, 38 cases in 1932; Hungary, 13 cases in 1932.

Poland registered 2,580 cases in 1922; 2,671 in 1923; 2,051 in 1924; 1,793 in 1925; 1,855 in 1926; 1,188 in 1927; 809 in 1928; 1,303 in 1929; 569 in 1930; 290 in 1931; 149 in 1932. In January and February 1933 only 44 localities were suspected of being contaiminated.

Bulgaria registered 225 cases in 1923; 351 in 1924; 533 in 1925; 4,214 in 1926; 1,575 in 1927; 1,107 in 1928; 500 in 1929; none in 1938.

Turkey registered 48 cases in 1922; 106 in 1923; 214 in 1924; 148 in 1925; 130 in 1926; 178 in 1927; 91 in 1928; 136 in 1929; 92 in 1930; 73 in 1931.

Sabry-Bey and Ganselmeier write that in 1929, 10 percent of all the horses in the Turksih Army reacted in a positive manner to mallein. Half of these were "dangerous", i.e., they were chronics, in whom, on proper provocation, the latent phase of glanders would pass into an active phase.

Below is a tabulation showing the number of registered cases of glanders for January-February 1933 for states, some of which were not mentioned in the enumeration above:

Belgium	1	Lithuania	None
Bulgaria	None	Latvia	None
Denmark	None	Japan	None
Finland	None	Norway	None
Greece	1	Poland	44

Number of stricken localities by European countries in 1932:

Austria	1
Germany	7
Hungary	13
Czecho-Slovakia	16
Greece	32

Italy	40	Poland	68
Spain	41	Yugoslavia	1,595
Turkey	57	Romania	186

GLANDERS IN PREREVOLUTIONARY RUSSIA

Glanders was well spread in Russia from long ago. The areas stricken with particular force were in the southern parts of the country. Since legislative counter-measures for the combatting of this disease were introduced only 1884, it is only from this date on that a more or less complete recording and reporting of the number of cases as well as the overall picture of the spread of glanders is available.

As per official statistics, the losses sustained through glanders from 1880 to 1910, were as follows (complied by Peshtich):

Table 1. Losses from Glanders during 1881-1910

Periods	Years	European Russia	Asiatic Russia	Caucasus
		Horses Perished		
I	1881 - 1885	3,280	432	69
II	1886 - 1890	8,404	606	62
III	1891 - 1895	20,728	1,888	274
IV	1896 - 1900	52,471	3,030	1,197
V	1901 - 1905	59,045	2,671	4,737
VI	1906 - 1910	76,009	4,007	7,475
TOTAL: ALL 6 PERIODS		219,937	12,634	13,814

The above Table shows that towards the VI period the epidemic is on the increase. The increase is annual, and at times even galloping.

The number of horses stricken is still on the increase during the subsequent years. Comparing the number of cases in 1910 and in 1911,

as per the last report of the Veterinary Department of the Ministry of the Interior:

Table 2. Loss of Horses through Glanders

Years	European Russia	Asiatic Russia	Caucasus
	Horses Perished		
1910	15,744	1,034	1,929
1911	21,772	1,424	2,410

Generally, the number of cases, or, more specifically, the number of registered cases in 1910, as compared to the same in 1880, has increased:

For European Russia	by	23.13 times
For Asiatic Russia	by	9.31 times
For the Caucasus	by	106.72 times

Losses through glanders for the entire prerevolutionary Russia in the year 1911, amounted to 0.7 percent of the total horse population.

In relation to other infectious diseases in 1911, glanders occupies a very significant place, amounting to 15.5 percent. Yet, these tremendous figures do not completely represent the real extent of the country's contamination with relation to glanders, and the real pattern can be pieced together only by approximation.

Peshtich points out, that the statistical data pertaining to glanders for the period 1881-1885, in the absence of regulations by the State, was far from complete. This was also the case during the years immediately after. The considerable increase in the number of stricken horses in European Russia, as reported for 1885, is due not only to the actual spread of the epidemic, but also to improved methods of registration.

THE GEOGRAPHICAL PROPAGATION OF GLANDERS IN PREREVOLUTIONARY RUSSIA

Peshtich furnishes the following data on the number of glanders-contaiminated guberniyas and localities:

Table 3. Number of Contaminated Guberniyas and Localities

		In European Russia		In Asiatic Russia		In the Caucasus		In all Pre-Revolutionary Russia	
Periods	Years	Gub	Loc	Gub	Loc	Gub	Loc	Gub	Loc
I	1881-1885	37	209	3	8	2	4	42	221
II	1886-1890	46	274	5	10	3	3	54	287
III	1891-1895	52	1,402	9	48	6	33	68	1,513
IV	1896-1900	55	3,372	12	225	9	109	76	3,697
V	1901-1905	56	4,004	13	173	11	256	80	4,433
VI	1906-1910	54	4,855	16	279	11	362	81	5,496

The above Table shows, that in European Russia only 6 guberniyas (out of 60) were safe from glanders, in Asiatic Russia only one guberniya out of 17 was safe, in the Caucasus only 2 guberniyas out of 13 were safe from the disease.

In European Russia the number of unsafe [contaminated] guberniyas, beginning with Period III (1891-1895), was almost stabilized, decreasing somewhat during the last period. The number of unsafe localities, however, was increasing at all times. If Period I is taken as a base, [with relation to unsafe localities], Period VI shows that base multiplied by 23.23. The same trend, i.e., the continuous increase in the number of unsafe guberniyas, and the number of unsafe localities during Period VI being 34.87 times that of Period I, is shown for Asiatic Russia.

The Caucasus shows the same trend. Beginning with Period IV the

number of unsafe localities rises abruptly, and is 25 times that for Period I, while the number of unsafe localities for Period VI is 90.5 times that for Peiod I. Peshtich explains the relatively lower increase in the spread of glanders in the European Part of Russia by the fact, that there was more veterinary personnel available to combat the disease. Such was not the case, particularly in the 1880's and 1890's, in Asiatic Russia. One additional reason for the greater numbers indicated is the improvement in diagnosis and registration methods.

In the Caucasus, counter-measures against glanders were lagging behind for a long time, and only at the beginning of Period IV (1896) some systematic planning was introduced. From this point on, the improved methods of diagnosis resulted in a tremendous increase in the number of reported cases, as well as in the number of oblasts, guberniyas and localities reported unsafe with regard to glanders.

The spread of glanders was not even, and individual oblasts and guberniyas were stricken to a various extent. Hardest hit was the South - 12 guberniyas and oblasts and practically all of the Northern Caucasus. The above area took in the following guberniyas and oblasts:

GUBERNIYA	Mean Annual Loss For All Periods (Number of Horses)
Bessarabia	541
Podolskaya	165
Kiyevskaya	360
Khersonskaya	4,126
Kharkovskaya	176
Saratovskaya	537
Kuban' Oblast	1,173
Terek Oblast	113
Don Oblast	506

The mean annual loss through the south of Russia during Period VI was 11,257 head, which amounted to 64.52 percent of the total loss sustained throughout all of Russia, and to 0.18 percent of the entire horse population of the world.

The Eastern area consisted of 3 guberniyas - Samarskaya, with a mean annual loss of 2,456 head; Ufimskaya, with a mean annual loss of 285 head; Orenburgskaya, with a mean annual loss of 678 head; and 2 oblasts - Ural'skaya, with a mean annual loss of 120 head; and Turgayskaya, with a mean annual loss of 144 head. The mean annual loss in this /Eastern/ area amounted to 21.1 percent of the total loss sustained throughout all of Russia, and to 0.11 percent of its available horse population.

There were two more areas, in which glanders assumed considerable proportions. The first area included Varshavskaya guberniya, with a mean annual loss of 275 head, and Polotskaya guberniya, with a mean annual loss of 120 head. The second area consisted of Kelotskaya guberniya, with a mean annual loss of 147 head.

However, the statistical data compiled by Peshtich, lags far behind the real extent of the spread of glanders in prerevolutionary Russia. Peshtich furnishes the figures relating to clinical glanders only, since the biological methods of diagnosis (malleinization) were used merely to confirm the clinical glanders. The serological methods, such as the agglutination test and the complement fixation test /CFT/, were still in the stage of laboratory research.

Voluminous experimental data, accumulated in the USSR, show that in areas, where the basic counter-measures against glanders took the form of quarantining and the destruction of its clinical forms, there still remained considerable numbers of horses afflicted with its

latent forms. An example of the numerical ratio between the clinical and latent forms of glanders could have been established before. During a well known outbreak of glanders amongst the horses of a Paris hansom cab transportation firm, it was established that out of the general number of 12,000 horses, only 535 were evidently infected with the clinical form of glanders, while 2,037 showed a positive response to the mallein test. That means, that for every horse evidencing the clinical form of the disease, there were 4 horses suffering from the latent form of glanders.

When counter-measures against glanders were initiated in the USSR, a head count of clinical examinations plus mallein tests for each examination were made. As a result, some areas, as for instance the Ukraine, showed for each clinically manifest case 5 cases reacting positively to mallein only. In the Northern Caucasus the ratio was 1 to 7.

In the south of prerevolutionary Russia the ratio between the clinically evident phase and the latent phase of glanders, according to sporadic data available, was of still greater divergence.

In 1913, the Ministry of War, troubled about reports appearing in the press as to the considerable propagation of glanders amongst the Army horse contingents, and as to the subsequent spreading of the disease throughout the country, appointed several special commissions to look into the matter. This resulted in official statistical data on propagation of glanders in the Army, based on clinical examinations and depicted in a book by Rudenko under the title "A Century of Russian Military Veterinarian Practice" (in Percent):

1898 - 0.092	1902 - 0.123	1905 - 0.153	1908 - 0.188
1900 - 0.102	1903 - 0.118	1906 - 0.150	1913 - 0.021
1901 - 0.104	1904 - 0.131	1907 - 0.168	

One of these commissions under the chairmanship of Professor Gordzyalkovskiy has examined with the aid of sub-cutaneous malleini-

zation 655 replacement horses delivered from the steppes beyond the Don. Two-hundred and forty-eight horses out of this number (37.8 percent) showed an allergy reaction. The same method was used in examining 1,269 replacement horses assembled in the Terek and Juban' oblasts of the Caucasus. One-hundred and ninty-five horses (15 percent) out of this number showed a positive reaction.

In the First Cavalry Reserve Regiment stationed in Syzran', 405 replacement horses delivered from the Kalmyk oblast were subjected to the mallein test, out of which number 124 horse (31 percent) showed a positive reaction. Out of 139 Kirgiz horses, 9 (6.4 percent) reacted positively to the same test.

Even these few biological tests already show, that the actual propagation of glanders was considerably higher than that shown in the official statistical data pertaining to this disease.

With the beginning of World War I, 1914-1918, the situation in the entire country with relation to glanders, took a sharp turn for the worse. A considerable number of veterinarians were called in by the Army, with the result that veterinary control and counter-measures against glanders were weakened. Also, great numbers of the available horse contingent were pressed into Army service, with the work load on the remaining animals considerably increased. This led to weaker resistance on the part of the remaining horses, in general, and, particularly, to the exacerbation of the glanders development process in horses suffering from the disease in its latent phase. In turn, the increased appearance of the acute stages of glanders led to a more rapid propagation of the disease.

The same process was running its course in the Army. Glanders amongst the Army horses was increasing as a result of the exacerbation of the latent stage within the ranks of the regular contingent, as well

as a result of feeding the horse contingent of the Army with replacements already infected.

No civilian statistical data is available for the period of World War I, and even the Army statistical data is incomplete. The data on the propagation of glanders at the North-western front (in percent of registered horse contingent), is as follows:

1915 - 0.52

1916 - 0.63

1917 - 0.83

CAUSES FOR THE PROPAGATION OF GLANDERS AND COMBATTING THE DISEASE

The Effect of Seasonal Changes and Local Conditions

Glanders is a chronical disease, and conditions resulting from seasonal changes during the year, are not as important for its propagation, as they are in the case of acute infectious diseases. Yet, the propagation of glanders during various seasons of the year is not the same.

According to the report of the Veterinary Office of the Ministry of the Interior for the year 1911, the total of 25,670 cases of glanders for the entire country, with relation to the seasons of the year, was distributed as follows:

Table 4. Propagation of Glanders by the Seasons of the Year /In numbers of Cases and Percent of Year's Total/

WINTER	January	February	SPRING	March	April	May
Cases	1,194	1,071	Cases	1,583	1,914	2,568
Percent	4.7	4.2	Percent	6.2	7.4	10.0

SUMMER				AUTUMN				
	June	July	August		September	October	November	December
Cases	2,533	2,712	2,733	Cases	2,617	2,854	2,194	1,697
Percent	9.9	10.6	10.6	Percent	10.2	11.1	8.5	6.6

The Table shows that from March to October there is a continuous increase, from 6.2 percent to 11.1 percent. Following this, from November to February, there is a continuous and regular decrease, from 8.5 percent to 4.2. percent.

Berezov, after studying the data for a limited area within Saratovskaya guberniya, with identical maintenance and epizootological conditions, made the following deduction (in percents of the total) from a total number of 6,829 glander-stricken horses for the period 1891-1900:

Table 5

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Percent	6.7	5.79	6.59	8.61	13.34	9.66	8.17	9.5	8.91	9.08	7.8	5.85

The sharp rise in April and May, Berezov explains by the transition from the latent processes of the disease to the "fully evident" processes, as a result of the spring toil in the fields. In the summer and early autumn the incre se in the number of glander cases is attributable to the maintenance methods, i.e., joint grazing, herd maintenance, joint toiling in the fields, and twin harnessing.

In Crimea, too, there are more glanders stricken horses registered in April, May, June, August and September, that is during the work in the field and immediately after. The peasants themselves noticed the effect of hard toil in aggravating the glanders situation. They used to say, that the horses are stricken "from over-exertion" (Shadrin).

During the winter the number of cases takes a drop, since the horses

are maintained under conditions of "natural individual courtyard isolation", and mass recontamination can take place only at public inns, courtyards, market assemblies, and country fairs (Berezov).

In different areas there might have been different conditions, either favorable or otherwise, for the propagation of glanders. Conditions depicted above were most typical for the south of Russia.

The effect of various counter-measures are also to be taken into consideration. Various prophylactic vaccinations, such as anti-anthrax, etc., were usually administered in the spring to horses and other livestock. Veterinary and sanitary inspections for the purpose of detecting glanders and other infectious diseases were also conducted in the spring. During the summer the anti-epizootic personnel was usually supplemented by veterinarian student-practitioners. Thus, the number of registered glanders-stricken horses at this time of the year was usually on the increase as a result of a greater number of relapses, on the one hand, and of intensified veterinary and sanitary counter-measures, on the other hand. Towards autumn, as will be seen below, part of the glanders-stricken horses were finding their way from landowner and other private economies into numerous peasant households, thereby escaping veterinary and sanitary control.

There is data in the above mentioned book by Peshtich relating to this particular condition.

Table 6. Propagation of Glanders by the Seasons

	European Russia		Asiatic Russia		Caucasus	
	No of Loc (in percent)	Ratio to Unity	No of Loc (in percent)	Ratio to Unity	No of Loc (in percent)	Ratio to Unity
Spring	26.74	1.00	22.23	1.00	30.75	1.00
Summer	28.54	1.07	32.99	1.48	26.28	0.85
Autumn	23.03	0.86	25.10	1.13	23.84	0.78
Winter	21.69	0.81	19.68	0.88	19.13	0.65

The Table shows that in the summer the number of contaminated

localities increases somewhat as compared to spring [The degree of contamination during the spring is taken as a base, or unity] In the autumn the number of contaminated areas begins to drop, and reaches its lowest point in the winter. Peshtich himself does not connect these epizootic fluctuations with any inherent characteristics of the disease, but considers them as basically predicated on maintenance conditions and the degree of veterinary and sanitary control available during the various seasons of the year.

Herd maintenance in the spring and in the summer, accompanied by inadequate veterinary-sanitary control and a time lag in the quarantining of stricken horses, promotes the propagation of glanders. The reduction in the number of stricken horses in the Caucasus during the summer is explained by the fact that during that season they are driven into the mountains, where, [although] there is no veterinary control, yet they are maintained in a state of isolation from other horses, which may be contaminated.

In other places such lack of veterinary control would occur also in the winter months on account of poor accessibility.

In the horse breeding steppes, such as those beyond the Volga, the Orenburg, and Ural steppes, the propagation of glanders as well as the counter-measures against it are predicated on specific conditions. Horses were bred and maintained in herds. The common grazing and the common watering of the herds were favorable to the propagation of glanders, but its extent was unknown [for a long time]. In the Kirgiz steppe beyond the Urals, there were in 1892, as per official data, 14 glanders-stricken horses (including the 104 mentioned above). The annual rate for the entire Ural oblast, including cities and Cossack villages, during the above decade, was from 70 to 119 stricken horses (Petrovskiy).

In 1898, 6,976 horses from the Ural oblast and Astrakhanskaya guberniya were driven into Saratovskaya guberniya. Out of this number, prior to the distribution of the horses amongst the population, a total of 39 horses perished from glanders or were destroyed. During the first year after the above distribution, 73 horses perished or were destroyed.

In 1913, all the replacement horses under the jurisdiction of the War Office were administered the mallein test. A positive reaction was registered by: 37.8 percent of the horses from the steppes beyond the Ural; 31 percent of the Astrakhan steppe horses; 6.4 percent of the Kirgiz steppe horses - in contradistinction to the general figure of stricken horses in the amount of 0.0359 percent as established by the inspection of 1897. Such a wide divergence can only be explained by the difference in diagnostic methods. In 1897 they used the clinical method of diagnosis, which does not insure the discovery of all horses suffering from glanders. In 1913 they used the allergy method of diagnosis, which is the most sensitive.

Glanders, as well as tuberculosis, syphilis, brucelliasis, can be considered as social phenomena, or social diseases.

The attitude of the State, society, and individual citizens, also the cultural level and the degree of economic welfare enjoyed by the State and its citizens, affect greatly the degree of propagation of the diseases, and the success of the counter-measures designed to combat them. If the value of each of the above indicated factors, as related to the propagation of glanders in prerevolutionary Russia, is analyzed in detail, it becomes clear why the disease of glanders was so prevalent during that time.

GOVERNMENTAL ACTION AGAINST GLANDERS IN PREREVOLUTIONARY RUSSIA

Prior to the publication by the Ministry of the Interior on 25

January 1884 of Circular No 120, no special measures against glanders were contemplated by law. Up to 1903, glanders, as a particular disease, was not even mentioned in the Medical Statute (Law Summaries, Volume 13.) It is hidden under the column "other cattle plagues". This fact speaks for itself, and serves as a clear indication of the part played by the Government at that time in the control of glanders.

Since up to 1884 (the year of publication of Circular Number 120) there was no law authorizing the destruction of a glanders-infected horse (such a law was issued in 1903), said destruction was permitted only with the consent of the owner. In the absence of such consent, the stricken horse was to be put away in complete isolation with a tag suspended from his neck inscribed "until such time as it will drop". A horse showing suspicious symptoms was to be put away with a tag inscribed "until such time as the character of the disease is ascertained".

Municipal and rural councils were furnished explanations dealing with the desirability, and even the necessity, of compulsory regulation, to include the destruction of glanders-stricken horses, with remuneration given to the owners of such.

Circular No 189 published in 1885 expanded these counter-measures to include asses and their cross-breeds.

It was in rare cases only, when owners would agree immediately to the destruction of badly-stricken animals, not to mention the animals merely under suspicion. It therefore became necessary to quarantine such stricken horses, or, to use the Peshtich expression, to "bring the owners around by the extreme emaciation of the isolated animals, a process that dragged out very long". Such "emaciation" regulations were of little effect in the struggle against glanders, yet, to use again a quotation from the Peshtich book, " it stimulated the rural councils and the local administrations to make a start in the right direction."

Efforts to "regulate" the struggle against glanders began immediately upon the publication of Circular No 120. A good indication of the trend of these activities can be had by analyzing the localities and the dates of publication of the first compulsory decrees, against the background of the relative importance of horse breeding or against the saturation point in the horse population, pertaining to the same localities.

Compulsory decrees were published, as follows:

In 1884 - by the Kalyazin County Council (Tverskaya guberniya); by the cities of Velizh and Nevel (County Seats in Vitebskaya guberniya).

In 1885 - by the Pskov County Council, the cities of Vyshniy-Volochek and Ostashkovo (Tverskaya guberniya) and Baku.

In 1886 - by the cities of Ves'yegonsk, Torzhok, Kashin and Staritsa (Tverskaya guberniya).

In 1887 - by the Ostashkovo County Council and the city of Korchevaya (Tverskaya guberniya).

In 1888 - by city of Rzev (Tverskaya guberniya).

In 1889 - by the Bessarabskaya guberniya Council (Zemstvo) etc.

Thus, the county councils (zemstvo) and cities of Vitebskaya, and, particularly, of Tverskaya guberniyas, turn out to have been the most progressive. The reason for this was the rare occurrence of glanders, amounting to perhaps one case a year. The city councils obviously were anxious to rid themselves of the disease once and for all.

On the other hand, the guberniyas and oblasts, where glanders was annually striking down hundreds and thousands of horses, issued compulsory decrees at a considerably later date. As follows:

Khersonskaya guberniya - in 1898.

The Don and Kuban' oblasts - in 1900.

The Terek oblast - in 1905.

The Crimea - in 1909.

The Akmolinsk and Semirechensk oblasts - in 1910.

Moscow and Moscovskaya guberniya occupy a special position with relation to the anti-glanders campaign. The first compulsory decree for the guberniya as a whole was issued in 1892, and for the city of Moscow - in 1900.

If we assume all the compulsory decrees published to be equal to 100 percent, the 1880's will account for 19.23 percent, the 1890's for 35.85 percent, the period 1900-1905 for 5.13 percent, the period 1906-1910 for 33.34 percent, the period 1911-1912 will account for 6.41 percent.

From the above depicted order of sequence, with which various areas embarked upon the anti-glanders campaign (as judged by the publication of compulsory decrees), it can be seen, that attention to the problem of glanders was rising not in a continuous, but in a rather irregular manner. The maximum attention was concentrated upon the problem of glanders in the years immediately preceding World War I. Up to 1912, out of the total of 60 guberniyas comprising European Russia, 11 guberniyas had no compulsory decrees. Out of the 17 guberniyas and oblasts comprising Asiatic Russia, only 4 had compulsory decrees. Out of the 13 guberniyas and oblasts comprising the Caucasus, only 2 had compulsory decrees.

With relation to the lag in the anti-glanders campaign on the part of Asiatic Russia and the Caucasus, Peshtich himself, who was the Chief of the Veterinarian Bureau of the Ministry of the Interior, wrote: "The necessity for combatting the disease of glanders in these areas has as yet not penetrated the consciousness of the local authorities and the local veterinary supervision personnel, to a degree, that would make for the proper tackling of the problem". One of the basic

points in combatting glanders by compulsory regulation was the voluntary declaration by the owner of a stricken horse, and his consent to the destruction of the animal. This was encouraged by the payment of a small sum to the owner of the horse (a so-called "reward"). Since the sum was rather small, and the owners of the stricken horses did not rush in with their declarations, most of the regulations specified a time limit within which the declaration was to be made. Otherwise, there was no reward.

In order to induce the owners of stricken horses to report immediately, some of the regulations stipulated that the reward would be commensurate with the working ability of the horse. The longer the disease remained unreported, the more emaciated the horse became, the smaller the reward to the owner after reporting. Thus, the time limit set for the reporting of a case of glanders was of major importance in the campaign.

Beginning with 1905, in accordance with the new Medical Statute, horses suffering from a clear case of glanders, were subject to destruction even without the consent of their owners. In various compulsory decrees the limits set for reporting differ considerably. In some guberniyas, such as Smolenskaya, Chernigovskaya, Tverskaya, no time limit is set. Sixty-seven decrees required an immediate report. The 10 guberniyas of the Vistula territory required a report within 24 hours. Kurlyandskaya guberniya, within 1-2 days. Tul'skaya guberniya and Vernoye (Alma-Ata) not later than on the third day. The various time limits set for the reporting of glanders were predicated on local conditions and habits, and, particularly, on available means of communication. The stipulation of the same 3-day time limit for reporting in such divergent areas as Tul'skay guberniya, on the one hand, and Vernoye (Alma-Ata), on the other, can only be explained by the personal

attitudes of the authors of the regulations.

With relation to the horses clearly afflicted with glanders, 72 of the decrees prescribedcompulsory destruction, while 5 of them permit destruction only with the consent of the owner. If the consent of the owner was not forthcoming, the horse was to be kept in strict isolation, until it perished (such was the practice in the Ural oblast and in Tverskaya guberniya).

As regards the horses merely under suspicion of glanders, the directives of the decrees were at even greater variance. Some guberniyas, such as Kaluzhskaya, Kovenskaya, Ufimskaya, Yaroslavskaya, Tverskaya, have no directives pertaining to this case. In other guberniyas the decrees requiredthe quarantining of such horses, or placing them under strict veterinary surveillance. But, again, there was great divergence in the specified time periods for the above. Some of the regulations prescribing quarantine or veterinary surveillance added: "until they perish or recover". Since this phase of glanders is a chronic stage the "until" was usually stretching out for months. Exactly such directives were to be found in the decrees promulgated by Bessarabskaya, Novgorodskaya, Tambovskaya guberniyas and by the Akmolinsk and Ural oblasts. In Peterburg the quarantine time period was established by veterinarian executive commissions. Other guberniyas specify a quarantine period of 2-3-4 months.

In 25 of the decrees it was required that the horses during the quarantine period receive the benefit "of all means known to science pertaining to glanders research". Nineteen decrees requiredthe use of the mallein test only. The rest of the decrees were silent on this subject.

The practical steps to be taken after the mallein test was administered, are found only in some of the decrees, but not in all of

them. Only in 4 decrees (Kurlyandskaya, Orenburgskaya, Permskaya and Tul'skaya guberniyas) were there definite instructions to the effect, that if the response to the mallein test was positive, destruction of the animal must follow. In 17 other decrees, under the same circumstances, destruction was also recommended, but with two stipulations: (1) either the owner's consent or confirmation by additional tests, such as mallein or other methods; and (2) the non-disappearance of clinical symptoms over a 2-month, or even longer, period of veterinary surveillance.

The measures recommended by the compulsory decrees with relation to a group of horses suspected of having been infected, also lacked consistency and follow-up. They were practically reduced to mere veterinary observation. The period of observation, in two decrees is 4 months; in 22 decrees, 3 months; in 19 decrees, 2 months; and in 2 decrees, 1 month. Some of the decrees left the method for establishing the degree of danger, constituted by this group, to the discretion of the veterinarian. Seven decrees gave instructions for the use of the mallein test, and the decrees by Yekaterinoslavskaya and Tul'skaya guberniyas advised the use of all known methods of research. The decrees by 19 guberniyas furnished no instructions at all.

The reward for the owners of glanders infected horses destroyed in accordance with compulsory decrees, may be considered as one of the counter-measures for the combatting of glanders. At first, beginning with 1884, the reward served as an inducement to the owner of the stricken horse, to agree to its destruction. After the promulgation of the new Medical Statute in 1905, the reward to the owner for the destruction of the horse remained in force, with the stipulation of a time limit for reporting to the authorities. Determination of the time

limits, as well as the rewards were left to the rural and municipal councils.

The rewards varied greatly: beginning with very high - two thirds of estimated value, and up to 400 roubles for a "luxury horse" in Liflyandskaya guberniya, or 300 roubles in Volynskaya guberniya, then coming down to 2 roubles in Bessarabskaya guberniya. In most of the guberniyas, the average reward was from 20 to 50 roubles.

The lack of coordination in determining the rewards for adjacent guberniyas is remarkable. For instance, Bessarabskaya guberniya paid out from 2 to 20 roubles per horse; Khersonskaya guberniya, half of the estimated value of the horse; and Tavricheskaya guberniya, 25 roubles per horse.

Such divergence in rewards resulted in the development of a very peculiar trade, a trade in glanders infected horses. For instance, in the Kuban' oblast the reward for the destruction of a stricken horse was 50 roubles, while in the neighboring Don oblast the reward was 45 roubles. However, the paying of the reward was conditioned upon the timeliness of the report and the non-discovery of the infected horse at the market place or the county fair. Also, it was forbidden to bring horses from other guberniyas, or to knowingly purchase an infected horse. The non-compliance with these stipulations deprived the owners of the rewards. Yet, in Stavropol'skaya guberniya, right alongside of the Kuban' oblast, there was no reward for the owners of infected horses that had to be destroyed. Profiteers were buying up infected horses in localities where rewards were low for a mere pittance, and drove them to the Kuban' oblast for reporting to the authorities and the subsequent high rewards. This fact is mentioned in the annual report for 1912 by Ivanov-Yudin, veterinarian inspector for the Kuban' oblast.

In order to stop this illicit trade, he lowered the reward from 50 to 20 roubles per horse, and predicated the paying out of the reward upon a minimum 6 month period of "residence by the horse" in the oblast.

An example of a stubborn, yet futile struggle against glanders, can be seen from the records of Khersonskaya gubernlya. The struggle against the disease there dates back to 1891. In 1912, senior veterinarian Borovskiy summarized the results in the annual report published by the Gubernskoye Zemstvo. For the entire period, 16,230 stricken horses were destroyed; 1,018,907 roubles was spent for counter-measures against the disease. Yet, the amount of money paid out in rewards to owners of stricken horses in 1912, was 26 times that for 1891. The number of stricken horses destroyed was continuously on the increase. From 1891 to 1895, 839 horses had to be destroyed. During the year 1912, 5,667 stricken horses were destroyed.

To some extent, this situation was due to the inflow of stricken horses from the neighboring gubernlyas, since Khersonskaya gubernlya was paying out in rewards one half of the estimated value of the horse. This was in contrast with the neighboring guernlyas paying out as follows: Yekaterinoslovskaya, up to 40 roubles per horse; Tavricheskaya, up to 25 roubles; Bessarabskaya, from 2 to 20 roubles. However, the basic underlying cause for the futility of the struggle against glanders, according to Borovskiy, was the absence of a unified all-state plan covered by general legislation.

VARIOUS POPULATION GROUPS AND THEIR ATTITUDES TOWARDS THE ANTI-GLANDERS CAMPAIGN

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In rural areas the people dealing directly with horses were the landlords, large estate owners, merchants, German colonists (in the South), smaller land owners of the farmer-kulak type, and peasants.

The statistical data compiled by Khersonskaya guberniya for 1912, and by Tavricheskaya and Saratovskaya guberniya for 1903, furnishes a clue as to the part played by various population groups in the propagation of glanders.

The Khersonskoye Zemstvo writes in its report: "The privately owned estates (by Germans and land owners) disposing of large numbers of horses, are strongly contaminated, and have a large percentage (50-85 percent) of glanders-stricken horses. The disease also is rapidly spreading from th se large holdings into smaller economies disposing of 6 or more horses." The harvesting of the crops done, the estate owners used to sell their weakened horses, i.e., those suffering from the chronic or latent form of glanders (Borovskiy), and buy new ones in the spring. Thus, the rotation cycle of the disease was assured.

Shadrin writes about the situation in Tavricheskaya guberniya: "The majority of wealthy horse owners, particularly the estate owners, the German colonists, and the more prosperous peasants, who own valuable horses, continue the practice of hiding the contaminated animals from veterinary surveillance." The presence of glanders in these economies is discovered only accidentally, either through head by head [veterinary] inspection, or after the infection of humans. The peasants, too, in order to squeeze the remaining labor out of them, are retaining the contaminated horses as long as possible. This is confirmed by the discovery of the chronic phase of glanders in most of the "declared" horses. With all that, the number of stricken horses declared by their owners, comprised up to 70 percent of all the glanders-infected horses.

Horse trading in the market places and at the country fairs was proceeding apace without veterinary control, since surveillance was sporadic or completely absent. In the winter, the horses were maintained in very unsanitary conditions. The temperature in the stables was so high that the attendants slept completely naked. The water wells were frequently located right there in the stables, for common use by man and beast. In addition, as a result of stark ignorance, there was "little faith in the local population pertaining to the communicative nature of glanders". All this resulted in such favorable conditions for the propagation of the disease, that 19.5 percent of all cases of stricken humans were to be found in Tavricheskaya gubernlya (Shadrin).

The same cycle of the disease is reported by Berezov for Saratovskaya gubernlya. On peasant farms repeated cases of glanders were observed in 23.3 percent, and on the large estates - 61.9 percent of all [known] cases.

GLANDERS IN THE ARMY

The routes by which the disease of glanders was spreading in pre-revolutionary Russia, were so diverse, that even Army horses in some cases became the source of the plague.

The Army horse contingent was receiving its share of glanders from the civilian authorities through horse replacements. The horse replacements for the Army were not subject to any biological tests, and were passed after a mere clinical inspection. As a result, horses suffering from the latent phase of glanders, found their way into the Army horse contingent.

The extent of this infiltration can be judged by the figures pertaining to losses in the reserve contingents attributable to glanders.

Thus, in 1910, these losses amounted to 35 percent of the total loss in the Army horse contingent; in 1911, to 39 percent; in 1912, to 32 percent; in 1913, to 42 percent.

From the reserves, the horses afflicted with the latent form of glanders, penetrated into the active detachments, where, due to good maintenance conditions, they showed very little clinical exacerbation of the process (only to the extent of 0.144 - 0.214 percent). The rest of these, all with chronic [clinically unidentifiable] glanders, after completing the term of military service, were returned to the civilian population. Here, under worsened maintenance conditions, they were suffering relapses and again became spreaders of the disease. Many of the Zemstvos openly declared that "glanders is propagated by Army horses". The Moscow municipal and guberniya councils, and the Khersonskoye and Ufimskoye Zemstvos, were particularly vociferous in this respect. The latter went as far as preventing the people from buying Army-rejected horses. It did the purchasing itself, but followed it up with mallein tests, subsequently reselling to the people only those horses that showed a negative reaction.

METHODS OF GLANDERS DIAGNOSIS USED IN PREREVOLUTIONARY RUSSIA

The Clinical and Bacteriological Methods

The basic method for the diagnosis of glanders was clinical inspection. Yet, even this was not done systematically, one by one, but sporadically, in the market places, during the ambulatory hours in the clinic. Only in some areas, such as Khersonskaya and Yekaterinoslavskaya gubernlyas, the Crimea, the Middle Volga, and several other gubernlyas, beginning with 1910 and after, until the outbreak of World War I, there were horse by horse inspections, wherever cases of glanders were observed.

The basic method of diagnosis used by the Army was clinical inspection and contamination of cats with the exudate from glanders lesions in horses. The obtaining of a typical bacterial culture in potato pulp was

the final diagnosis establishing the presence of glanders. These methods, used up to the outbreak of World War I, were obviously far from thorough, and, combined with other deficiencies along the line, they were not instrumental in eradicating the plague.

THE ALLERGY METHOD

Mallein, first prepared by Gel'man and Kal'ning in 1891, was used not long after its discovery by individual veterinarians in the Zemstvos. Beginning with 1903, the mallein test was being heralded by individual /forward looking/ Zemstvos as the best method for diagnosing glanders. In 1908 the Ministry of the Interior has authorized this method for the entire country.

Mallein, as a diagnostic medium, was tested in all countries, and in 1895, at the VI International Congress of Veterinarians, its diagnostic value was discussed. In 1900, the Ministry of the Interior, "concerned with bringing order into the business of mallein diagnostic injections, in view of the conflicting opinions as to the practical value of this medium, decided that, preliminary to the discussion of rules and regulations for the application in Russia of the mallein test for the diagnosis of glanders, the governments of the most important states of Western Europe be approached, through the Ministry for External Affairs, with a request to furnish it with information on all laws and ordinances operating in each state with relation to the application of mallein."

Replies were received from Austria-Hungary, Belgium, Denmark, Switzerland, Holland, Prussia, Bavaria, England, Italy, Spain, Sweden, and Norway. They show that in some states the mallein test was prescribed by official government regulation, as in Austria, Switzerland, Denmark, Italy, since 1893, and in England since 1894.

In 1905, at the VIII International Congress of Veterinarians, the typical positive, negative, and doubtful reactions to the mallein test, were standardized.

Only in 1908, by a Circular of the Minister of the Interior, mallein was confirmed as the official diagnostic medium for Russia.

In 1909, the mallein test was introduced into the Army, but its application was of short duration. In 1910, the orders were countermanded. By order Number 120, the Minister of War [explicitly] prohibited the use of the mallein test, head by head, in the case of replacement horses, staggered Cossack Commands and Military Detachment horses, and horses that have been in close proximity to horses afflicted with glanders. In other words, this order prohibited the use of the mallein test specifically in those cases, where its application was most urgent in order to discover the latent form of glanders. The same order prohibited the use of ophthalmo-malleinnization, and the destruction of horses without clinical symptoms, but with a positive reaction to the ophthalmo-malleinnic test.

The fate of the mallein test amongst the troops of the border detachments was even sadder than described above. Up to 1907, its use was still tolerated, but now it was completely prohibited.

The extent to which the mallein test was applied under the jurisdiction of the civilian authorities, and its value in the continuous struggle against the disease, may be judged by the number of mallein tests administered as against the total number of [known] cases of glanders.

According to Peshtich, from 1896 to 1908, 176,831 horses were afflicted with glanders, yet only 74,844 horses were given the mallein test. Mallein was used mainly in those areas, where cases of glanders were very numerous. Khersonskaya guberniya occupied the first place with relation to the extensive use of the mallein test, with an annual average of 2,414 tests. But, even here, it amounted to only 0.61 percent of all [known] cases of glanders. Then follows: Yekaterinoslavskaya guberniya with 900 tests, Kiyevskay guberniya with 636 tests, Khar'kovskaya guberniya with 346 tests, Tavricheskaya guberniya, where during the VI period there were

1,743 stricken horses, with only 250 mallein tests administered, Bessarabskaya guberniya, with only 92 mallein tests as against 543 afflicted horses. In the Don oblast 12 mallein tests were made, in the Terek oblast 2 tests were made, in the Kuban' oblast no mallein tests were administered. In Saratovskaya guberniya only 25 mallein tests were made, as against 2,506 [known] cases of glanders.

In 1911, 21,866 mallein tests were made as against 21,774 [known] cases of glanders in European Russia, which shows that in this part of the country the mallein test was assuming a relatively great diagnostic importance. At the same time, in the Caucasus, only 457 tests were made as against 2,424 stricken horses, and in Asiatic Russia, only 838 tests were administered as against 1,472 stricken horses.

The part played by mallein, in the struggle against glanders in Russia, can be judged by the quantity of mallein made available. According to Matveyev, 261,000 doses of mallein were made available during the period 1893-1908. This amount is considerably less than the amount now being prepared in one year.

It should be assumed that, in areas which used larger quantities of mallein, the struggle against glanders was more effective. The largest quantities of mallein during 1906, 1907, and 1908, were requested by the following guberniyas: Khersonskaya - 24,600 doses, Kiyevskaya - 11,000 doses, Yekaterinoslavskaya - 8,200 doses, Peterburgskaya, Saratovskaya, Simbirskaya, Tavricheskaya - 2,000 doses each. The horse breeding oblasts and guberniyas requested mallein in the following quantities: the Don oblast - 1,000 doses, Astrakhanskaya guberniya - 100 doses, the Kuban' oblast - 145 doses, the Ural oblast - 1,300 doses, Stavropol'skaya guberniya - 159 doses, Samarskaya guberniya - 819 doses, Voronezhskaya guberniya - 964 doses.

The above data shows very clearly, that during the period involved, the allergy method of diagnosing glanders played a secondary part [only].

The mallein test was administered to the stricken horses only for the purpose of confirming the clinical diagnosis, but not as an independent means of bringing to light the latent phases of glanders.

These were the diagnostic methods with which Russia entered into World War I. It was out of dire necessity to expedite the diagnostics of glanders against the backdrop of war, that the army finally authorized the use of the ophthalmo-malleinnic test in order to introduce greater precision into clinical diagnosis. At the same time, in Germany, where before the war the mallein test was not considered as adequately specific, and instead of it, blood tests were conducted (complement fixation tests), the ophthalmo-malleinnic test was now authorized as the official method of diagnosis.

SEROLOGICAL METHODS

The serological methods of research into the disease of glanders were being investigated, but had no wide practical application. The agglutination reaction and the complement fixation test were used for purposes of diagnosis. In the middle of the imperialist war, in 1916, the laboratory of the Northwestern front, under the supervision of Professor Ruzhentsev began to apply the modern methods for the diagnosis of glanders — the ophthalmo-malleinnic test and the complement fixation test. These methods, however, came into their fullest application only under the power of the Soviets.

SCIENTIFIC RESEARCH IN THE STUDY OF GLANDERS IN PREREVOLUTIONARY RUSSIA

Beginning with the 1890's, Russia was becoming one of the most important countries with relation to the study of glanders. The first scientific research into glanders to assume great practical value was the discovery and the preparation of the allergy compound known as mallein - both accomplished in Russia in 1891. These discoveries were made simultaneously, at the Yur'yev Veterinary Institute by Kal'ning, and at the Peterburg Institute of Experimental Medicine by Gel'man. After the prep-

aration of mallein was accomplished, the study of its diagnostic properties and its practical application began. However, as can be seen from the preceding text, other European countries overtook Russia in recognizing mallein as the official diagnostic compound.

The subsequent studies of the problems presented by glanders, such as: the development of methods for the manufacturing of mallein, the determination of conditions for obtaining a most potent and specific compound, the development of serological methods, the pathology of glanders, - all these took place mainly in the Epizootological Department of the Institute of Experimental Medicine, under the supervision of Professor Vladimirov.

The Epizootological Department of the Institute of Experimental Medicine of that time, was the center of glanders studies, which attracted many research workers from the outlying areas of the country, who arrived there to specialize in the field of bacteriology, the study of glanders, and other zoonotic diseases. The problems of serological-diagnostics of glanders were under intensive study in several places, such as the Veterinary Laboratory of the Ministry of the Interior in Peterburg, by Fedders, the Khar'kov Veterinary Institute, by Professors Dedyulin and Konev, in some laboratories supported by guberniya Zemstvos, as, for instance, in Kherson by Professor Mikhin, and in Saratov by Shaburov.

During the period from 1900 to 1910-1911, several commissions, charged with the study of the diagnostic value of mallein, were organized. They also studied the significance of the agglutination reaction and the complement fixation test (CFT). A commission, under Professor Gordzyalkovskiy, was laboring in the south of Russia under instructions from the War Office, to determine the number of army replacement horses reacting to the mallein test. The results produced by the work of this commission were related in the preceding text.

Granted all the deficiencies in the struggle against glanders, as per preceding text, there were at times more hopeful developments. In 1908, Konev, a docent of the Khar'kov Veterinary Institute, approached some of the Zemstvos for assistance in conducting vaccination tests, which showed hopeful possibilities, in his laboratory. The response came first from the Zemstvos of the southern guberniyas, then from the central areas of the country. Altogether, 14 Zemstvos allocated money for the purpose. The /Imperial/ Don Horse Breeding Station furnished a parcel of land near the railway station of Velikoknyazheskaya. Thus, came into existence, in 1909, the Velikoknyazheskaya Anti-Glanders /Experimental/ Station. The money allocated by the Zemstvos (30,000 roubles) was used for the construction of stables and other structures, and for the purchase of 200 horses.

General supervision was placed in the hands of an executive committee, the members of which were designated by the Zemstvos. The scientific supervision and authority was vested in Konev.

The program of scientific research, developed by Konev and approved by the Committee, comprised the following studies:

1. Prophylactic-therapeutic vaccinations with dead glanders microbes and live vaccines.

2. The obtaining of a hyper-immunizing serum and the study of its therapeutic value.

3. The checking of the Marksor and Levi experiments relating to active immunization against glanders.

4. The study of glanders diagnostics.

5. The course of therapy required by glanders-stricken horses.

The Experimental Station was in operation for 3 years, and closed down in 1912. The results were insignificant. The vaccination with dead microbes was unsuccessful. Vaccination with live vaccines, prepared by Konev, created stability against virulent microbe contamination, but the

vaccination itself was inducive to chronic glanders in the horses. The hyper-immunizing serums produced neither a prophylactic nor a therapeutical effect. Nothing new was developed in the field of glanders diagnostics and therapy.

The underlying reasons for the failure of this undertaking can be traced to the complexity of the task at hand, as well as to organizational confusion.

Some of the basic problems dealt with, such as vaccination, the preparation of hyper-immunizing serums, the therapeutics of glanders, are still awaiting their final solution.

The organizational structure itself did not make for successful accomplishment. Supervision was in the hands of an administrative committee of ten members, representing the Zemstvos. The members of the committee were changing constantly, resulting in shifts of policy and direction. Konev resided in Khar'kov, from where he attempted to guide the work by remote control. There was only one doctor-manager in residence at the station, shifted twice within a period of 3 years, who at the same time was functioning as the bacteriologist and serologist, and 3 veterinary assistants.

Towards the end of World War I, in connection with the considerable spread of glanders in the army of the Northwestern front, a field laboratory was set up in Smolensk under Professor Ruzhentsev. It was this laboratory that, for the first time in Russia, with official approval, introduced modern diagnostic methods, such as the ophthalmo-malleinnic test and blood analysis by the complement fixation test (CFT). Beginning with 1917, this laboratory took over the general production of mallein from the Institute of Experimental Medicine. Thus, by the end of World War I, the center for research, and the application of the latest diagnostic methods in the campaign against glanders, was shifted from the stationary institutions to a field laboratory.

CHAPTER SIX

EPIZOOTOLOGY OF GLANDERS

CONDITIONING FACTORS IN THE ENZOOTIC AND EPIZOOTIC PROPAGATION OF GLANDERS

Glanders, by its propagation characteristics, does not belong to the rapidly spreading infectious diseases, and, therefore, cannot be considered a pure epizootic disease. According to Vicheleeskiy, the basic factor in the propagation of glanders is the direct contact with an afflicted animal and recurring mass infection. His experiments show that "at least 48 hours of joint quartering of an evidently stricken horse with a healthy one is necessary for the latter to take ill. If the horses are separated before the expiration of this period, the healthy ones will not show any typical glanders symptoms, but only a temporary rise in temperature." The above quoted experiment by Missner, on the mixing into horse fodder of considerable quantities of pathological matter, without subsequent illness occurring, also confirms the fact that the alimentary route of infection with glanders is sometimes a difficult one.

Such experiments are not on record in sufficient numbers to warrant a definite conclusion. Yet, there is no doubt that the alimentary contamination with a glanders culture, or glanders pathological matter, require larger quantities of same, than subcutaneous contamination.

The slow propagation of glanders was already mentioned before, as an epizootological feature of the course taken by this epizootic disease.

Berezov, in relating his observations on the propagation of glanders over a 10-year period (1891-1900) for Saratovskaya guberniya, writes: "Glanders in rural areas, as well as in the cities, is a household epizootic disease. Although the declarations on the appearance of the disease were not always prompt, we not only fail to encounter the mass contamination of peasant households, but, what is even more surprising, in the already

contaminated households there is very frequently only one stricken animal. On the average, the number of contaminated households with recurring cases did not exceed 23.3 percent, although seemingly conditions were favorable for head by head contamination of the horses in the already contaminated households." The number of contaminated households during the above period was 178 at its minimum and 257 at its maximum.

The conclusions drawn by Berezov are based on a clinical diagnosis. Up-to-date biological methods of diagnosis would no doubt segregate greater numbers of afflicted animals. Yet, the data furnished by Berezov does attest the rather slow propagation of glanders infection. However, in the presence of aggravating factors, such as the crowding of horses in feeding and watering places, unrestricted grazing in meadows or indoors, weakening of resistance through various external and internal causes, transfer of contamination from outside sources, the process of propagation of the disease becomes more rapid.

Another characteristic feature of glanders is that having once appeared in an economy, [a certain area of agricultural economic activity] it remains there until [adequate] counter-measures are effected for its complete eradication.

The above enumerated properties of glanders, such as its slow rate of propagation, its more or less limited scope, its stationary nature, make it a characteristically enzootic infectious disease.

However, glanders, as practically any other enzootic disease, can, under conditions favorable to its propagation, assume the character of an epizootic plague, embracing considerable areas and large numbers of animals. Thus, in the past, as was related in Chapter One, the propagation of glanders in the South of prerevolutionary Russia assumed the characteristics of an epizootic plague.

The enzooticity and other epizootological properties of the glanders infection are determined by both the pathogenic incentive of the glanders process and the reaction to it by the organism of the animal, as influenced

by the background of all the external conditions to which the individual animal, or the entire group of animals, is subject.

The glanders microbe is not sporogeneus and does not belong to the group of microorganisms, capable of long remaining alive outside of an animal body. Its life duration outside of an animal body, as shown by the results of considerable research, is 2-3 weeks, and only some individual authors (Löffler) determine it to be 2-3 months. Such instability of the microbe does not add to the enzootic properties of glanders. On the other hand, the same microbe in the organism of a horse, has tremendous stability. There is no clear experimental data available to indicate as to what may be the causes which will kill the glanders microbe established in the body of a horse. Humoral bactericidal substances with a lethal effect on the glanders and some other microbes, are not found in the serums and fluids of healthy, or sick, or hyper-immunized horses and other animals. There is only one indication, by Vladimirov, that the fluid from the inflammatory edema in the sub-cutaneous cellular tissue, after the introduction of mallein, has bactericidal properties. Adequately clear indications are also lacking as to whether phagocytosis can destroy the glanders microbe.

Neither individual leucocytes nor the giant cells are capable of destroying, digesting or ingesting the glanders microbes, which survive their attack, and begin to perish only when the glanders lesion becomes surrounded with a connecting tissue, or is calcified. In other words, the glanders microbe can be found alive in the body of a horse a long time after the original contamination. The ability of the microbe to endure for a long time in the body of the animal, without losing its virulence, is one of the main factors, determining the enzootic course of glanders.

The incentives of enzootic infections, like Koch' bacilli, Brucella and glanders microbes, have no sharp toxic properties, as a result of

which the pathological process in the body of the afflicted animal can drag on for a very long time. Thus, the stricken animal can continue for a long time to be not only a bacillus carrier, but also a bacillus generator, when conditions favorable to the sharpening and intensification of the pathological process develop. This is what takes place in a horse during the glanders process.

The reactions of the animal's organism to the effect of the glanders microbes multiplying in it, and the toxic substances discharging into it, are taking either the form of an acute inflammatory process of alterative-exudative nature, or a quiescent process, where alteration is accompanied by productive inflammation. As a result, some of the animals show only slightly pronounced clinical symptoms of the disease, and some have no discernible outward symptoms at all. Such latent phases of the disease may dwell in the animal for a very long time.

Milovazorov and Glukhov, in their thesis on the virulent form of glanders, describe a case in which 9 horses, suffering from chronic glanders, were under observation. Upon provocation, there was a rise in temperature, and a glanders bacteria culture was segregated from the lymphatic nodes. After autopsies were performed (B. G. Ivanov), calcified lesions were found in some cases, and sometimes there were no glanders lesions at all.

The long duration course of the disease in its latent phase, or with weak outward symptoms, makes diagnosis difficult, and gives stationary, or enzootic, characteristics to the infection.

THE PROCESS OF GLANDERS AND ITS CLINICAL MANIFESTATIONS

The enzootic course run by glanders is, in addition to being a biological phenomenon, also an economic and even social phenomenon, subject to the influence of government, public organizations, and individual citizens. In keeping with the nature of these influences, the enzootic course of glanders showed corresponding variations.

In the 1880's-1890's, and the first several years of the following decade, it was characteristic, that in areas of high glanders propagation, there were many cases when, alongside of clinically evident phases, the course of the infection was one of long duration, with a mild development of specific lesions, and a trend to self-liquidation of the active phases, i.e. a non-malignant course. This non-malignant course is known also in the case of other chronic epizootics, such as tuberculosis and brucellosis.

It was already mentioned, that in the south of Russia, the course of glanders was frequently non-malignant. Vorontsov, (1880's-1890's), observed in the Odessa Military District a considerable number of horses undoubtedly infected with glanders, yet apparently healthy.

Shadrin, (in 1903, describes the non-malignant course of glanders in the horses of Tavricheskaya guberniya: "The glanders symptom complex in a good half of all the horses undoubtedly infected with the chronic nasal phase, shows itself, mainly, by a hardly perceptible mucous-purulent, or a watery discharge from the nose, or, when the discharge is completely absent, there is a hardly perceptible enlargement or swelling of the ~~sub-~~ ~~maxillary glands~~ cervical lymph glands; in the presence on the nasal septa of glanders ulcers, and, particularly, glanders scars (asteriated and radiated). Such horses, most frequently observed in private households, retain good appetite, make a healthy appearance, and are not suspected by their owners as infected with glanders."

The above is reinforced with statistical data. Out of 4,053 infected horses destroyed, only 2,170 (53.5 percent) had sharply pronounced glanders lesions, such as purulent nasal discharges, ulcers and scars in the nasal chamber, on skin, and swollen ~~submaxillary lymphatic ganglia~~ cervical lymph glands. In 1,883 horses (40.5 percent) the symptoms of nasal glanders were hardly perceptible: the mucous-purulent nasal discharge was hardly to be noticed, the swellings of the ~~submaxillary lymphatic ganglia~~ cervical lymph glands were much milder. In 430 horses, (10.5 percent), these swellings were hardly perceptible, or completely absent, a mild nasal discharge taking its place.

The same author furnishes data on the phases and localization of the glanders process, assembled on the basis of a study of 2,380 glanders-stricken horses, which were destroyed during the years 1899-1900.

Table 9. Phases and Localization of Glanders

Phases of Glanders	1899 Number of cases	1899 Percent	1900 Number of cases	1900 Percent
Acute nasal	192	18.6	248	19.20
Chronic nasal	837	77.0	990	76.25
Acute nasal and skin	11	1.0	33	2.55
Chronic nasal and skin	23	2.0	---	-----
Skin	4	0.15	2	0.15
Nasal and Lungs	2	0.05	---	-----
Nasal, Skin, and Lungs	15	1.2	19	1.55
Chronic lung	---	----	4	0.30
Total	1,084	----	1,296	-----

The above data shows that the chronic phases of glanders comprise 77-76.25 percent. Since no autopsies were made, there is no information here on the lung infections. This gap is filled in by Petrovskiy, who furnishes data on 693 glanders-stricken horses, which were destroyed, with autopsies following, during the period, 1895 - 1903, in the Ural oblast. In their make up, this group of horses, being working horses from the Cossack villages and cities, resembled the group analyzed above.

Localization of glanders infections (in percent):

Nose, lungs	92.06	Nose	1.73
Nose, lungs, skin	2.45	Lungs	0.86
Lungs, skin	2.02	Nose, skin	0.43

The infections in 1,388 horses were distributed as follows (in percent):

Chronic and Acute Phases	36.88
Chronic Phase	13.49
Acute Phase	49.63

Thus, the number of infections localized in the nasal area amounted to 95 percent. The number of infections striking at the lungs was approximately the same.

In later periods such infections are not noted. Only Eberbeck, who studied glanders during World War I, mainly on Russian war prisoner horses, reports the result of 300 autopsies: Lung infections in 97 percent of all cases, nasal infections in 56 percent. According to other investigators, who studied the horses during the period of liquidation of the consequences of the imperialist war, at the time the anti-glanders campaign was at its height, or at its closing stage, the number of nasal infections is still less.

Chernyak furnishes data relating to two periods of the struggle against glanders: Period I, or the period of full swing, and Period II, or the closing period of the struggle.

Table 10. Data on the Anti-Glanders Campaign for Two Periods

Period	Number of Horses	Glanders Detected	Glanders not Detected	Phases of Glanders	
				Active	Passive
		In Percent			
I	82	97.56	2.44	60.00	40.00
II	153	90.84	9.16	37.41	62.59

Table 11. Localization of Infection

Period	Number of Horses	Lungs	Nasal Chamber	Larynx and Trachea	Liver	Spleen	Skin
		In Percent					
I	80	93.07	35.00	26.25	41.25	30.	10.5
II	139	85.61	24.46	19.41	28.80	23.10	2.15

Table 12. Characteristics of Infection

Period	Nasal Chamber Infections: Number of Horses	Ulcers	Scars	Ulcers and Scars	Lung Infections: Number of Horses	Active Phase	Passive Phase
		In Percent					
I	30	30.0	53.34	16.66	119	32.61	67.40
II	34	0	73.55	26.45	75	56.00	44.00

Finally, there is a special summary on the results of autopsies during the same two periods:

Table 13. Results of Autopsies

Period	Number of Horses	Glanders not Detected	Glanders Detected	Phases: Active	Passive
		In Percent			
I	78	2.56	97.44	50.00	50.00
II	75	16.0	84.00	22.22	77.78

The above data shows that with the intensification of the anti-glanders campaign the evident clinical infections gradually decrease, the acute phases recede, and their place is taken by the chronic forms, the number of horses suffering from the active process of the disease is becoming smaller, while the number of horses undergoing the passive, or latent process, is on the increase.

The characteristics of the subsequent variations in the course of the disease in connection with the anti-glanders campaign, can be understood by referring to the thesis prepared by Vorontsov and Romanov. They investigated the horses during the period of final liquidation of glanders (3-4 years after Chernyak), practically, in the same economies. The horses were examined systematically over a period of many years, showing a negative reaction to the complement fixation

test (CFT), and a positive reaction to the ophthalmo-malleinnization test. The mallein-tested horses were segregated into a special "mallein group" and kept [within that group] from 5 to 31 months. The diagnostic reactions in this group were the same, with the exception that the ophthalmic [component of the ophthalmo-malleinic reaction] would at times disappear, but then it would return again. There were 30 horses in this group. Twenty-four of them perished through causes not related to glanders. Four of them were destroyed since they began showing positive and doubtful reactions to the complement fixation test (CFT).

[Out of the above number of horses (30)], 18 showed up with glanders lesions, after pathological and hitological investigations, while 12 showed no lesions.

Table 14. Localization of Infections in Organs

Organs Stricken	Number of Horses	Organs Stricken	Number of Horses
Lungs	10	Nasal Septum and Lymphatic Glands	1
Lungs and Lymphatic Glands	4	Nasal Septum	1
Lymphatic Glands	1	Liver	1

The characteristics of the lesions discovered were exclusively chronic -- complete incapsulation and calcification (B_4).

Only one horse, which after being in the "mallein group" for a long time, began to show a positive reaction to the complement fixation test, had, alongside of lesions B_4, also lesions belonging in category B_2. The number of lesions discovered in all the horses was very small, from 3 to 5.

Thus, on the basis of morphological studies of glanders lesions, and also on the basis of bacteriological research performed by Missner, Eberbeck, Landa, and Karpov, to the effect that no glanders culture could be obtained, and only in a very insignificant number of cases was the glan-

ders microbe segregated from the incapsulated lesions, as described above, - the conclusion can be drawn that the horses with lesion forms Б, are recovered not only clinically, but biologically as well.

It would have been reasonable to assume, that horses, in whom no glanderous lesions were discovered on autopsy, yet, while still alive, reacted positively to mallein, were not infected with glanders. Such, however, was not the case. According to research performed by Milovzorov and Glukhov, during these phases of the glanders process, microbes may be present in the organism of the horse while alive. In the same thesis, Milovszorov and Glukhov report that they frequently observed a clinical exacerbation of the glanders process as a result of its provocation by a dead glanders culture. The same horses, upon autopsy, did not show any glanderous lesions, "which would indicate the presence of a non-compensated phase of glanders." (Works of the Veterinary Research and Experimental Station for the Azov-Black Sea Territory, Volume 5, Page 41).

EPIZOOTOLOGICAL CHARACTERISTICS OF GROUPS OF MALLEINNIC HORSES

Horses reacting to the mallein diagnostic tests are known as malleinnic horses. Horses are segregated into malleinnic groups after a definite complex of counter-measures against glanders has already been applied, such as: clinical examination and the destruction of the obviously infected animals; the mallein test and the complement fixation test applied to the survivors, with those reacting positively to the complement fixation test (CFT) segregated into a separate group. Horses showing only one positive allergy reaction, without clinical symptoms and serological reactions, are malleinnic horses, and they are assembled at "concentration points for malleinnic horses" (PKM). Thus, these malleinnic horses are a group in various stages of the chronic glanders process. Amongst them are horses with stably compensated phases, and some in phases of non-stable compensation, also horses with still active phases of chronic glanders, but with a temporary loss of biological reactions. Into this group

will also come horses with an exacerbated glanders process, or a secondary infection contracted from other malleinnic horses. Finally, horses with the latent phase of the disease, or even those, in whom the disease is only in its incubation period, are relegated into this group. Thus, it can be seen that, with relation to the form and stage of the glanders process, the malleinnic horses do not constitute a homogeneous group.

The degree of non-homogeneity in the composition of groups of malleinnic horses will be the greater, the less the period of time, and the worse the planning involved in the counter-measures. And if the group of malleinnic horses is made up of horses segregated from various economies, its composition, with relation to forms and stages of the glanders process, will be even more heterogeneous. The opposite will be the case, when the malleinnic group is made up after well planned and continuous counter-measures were put into effect over a considerable period of time.

In 1924, after a well planned anti-glanders campaign, conducted with relation to a considerable group of horses, was in its final stages, the horses reacting to the mallein test were segregated. In the course of the next year, out of the number of malleinnic horses, 2.7 percent showed rather unclear clinical symptoms of glanders. Twelve of these were destroyed, eight left in quarantine, and the remainder, upon additional investigation, released.

The picture was different, when the malleinnic group was made up of horses from various economies, in which there was heretofore no well planned anti-glanders campaign. Karpenko investigated a considerable group of horses in the PKM category [malleinnic]. The group was made up in October 1931, with the investigation beginning in November. After clinical examination, ophthalmo-malleinnic tests, and blood examination by the complement fixation test (CFT), 2.3 percent showing clinical symptoms were destroyed. After a two-time blood examination by the complement fixation test, 18.97 percent were destroyed. During 1932, complement

fixation tests were made every 3 months, and clinical examinations conducted every month. As a result of the March investigations, 5.12 percent were destroyed by CFT verdict; at the end of June 6.55 percent, at the end of September 5.84 percent, at the end of December 2.5 percent. For the same period, clinical symptoms appeared: in May 0.36 percent, in July 0.96 percent, in August 1.2 percent, and in September 1 percent.

Horses with positive reactions to the mallein test and CFT were destroyed, with subsequent autopsies. Out of 64 horses, 29 showed glanders (45.3 percent). Out of these 29, 68 percent showed an active process. Thirty-nine horses reacted only to an eye test, and out of these, glanders was present in 17.94 percent of the cases (5.12 percent in an active process, and 12.82 percent in a passive process).

This proves, that in an assembled group of malleinnic horses, right after the assembling is accomplished, there is considerably more subsequent segregation, not only of horses showing biological reactions, but also those being segregated on account of the exacerbation of the glanders process.

Great numbers of various active forms of glanders were discovered by Milovzorov and Glukhov in newly assembled, and even in old, malleinnic groups. The work of these two men had as its practical purpose, the elimination of all horses with the active stage of glanders from the malleinnic group.

In a group made up of 42 horses, segregated from economies not long before the beginning of the experiment by a double test (complement fixation test and, after 15 days, ophthalmo-malleinnic test), 14 horses were reacting positively to both methods, 28 horses reacted negatively to CFT and positively to the ophtalmo-malleinnic test. All horses received a sub-cutaneous injection of mallein in the amount of 2 cubic centimeters, to which all horses but one reacted in a conventional manner. One of the

experimental horses perished on the fifth day. The autopsy showed the presence of exudative glanders-like bronchial pneumonia, and active glanderous lesions in the lymphatic system. After the introduction of mallein, all the horses were subjected to a blood test by CFT.

By the results of the complement fixation tests prior to, and after, malleinnization, the horses were separated into 3 groups:

Group I -- 14 horses. Ophthalmic reaction positive; reaction to CFT prior to mallein injection positive. Autopsies established the following: 9 horses (64.29 percent) with active glanders, 5 horses (35.71 percent) with inactive glanders. The forms of active glanders: one horse had ulcers on the nasal septum, another horse had caverns in the lungs and numerous lesions; 7 horses had active pneumonic nuclei and lesions in the lungs and lymphatic glands.

Group II -- 14 horses. A positive ophthalmic reaction and a positive reaction to CFT, after the mallein injection. The autopsy showed as follows: 4 horses (28.57 percent) had active glanders, and 10 horses (71.43 percent) inactive glanders. Forms of the active glanders: one horse had three caverns in the lungs of the size of chicken eggs, many lesions and ulcers in the trachea; 3 horses had non-incapsulated and incapsulated lesions with zones of hyperemia around them.

Group III -- 13 horses. A positive ophthalmic reaction, a negative reaction to CFT, prior to and after malleinnization. Autopsies showed no active glanders processes.

Thus, according to the above data, amongst the horses recently assembled into the malleinnic group, there are considerable numbers with active glanders, with forms of lesions that will cause a considerable generation of glanders microbes, such as ulcers on the nasal septum, ulcers in the trachea, pneumonic nuclei and caverns in the lungs. The horses were destroyed within a month after the mallein injection, and it is reasonable to suppose that the state of the glanders process within their bodies, as shown by autopsies, should be close to the state in

which they were originally assembled into the PKM [malleinnization concentration points].

A group of 20 horses were located a long time in PKM. The group did not show any clinical symptoms of glanders. The ophthalmic reaction was positive, the reaction to CFT was negative. Upon provocation with a dead microbe culture of glanders, 5 horses came down with active glanders, out of which number, 3 developed ulcers of the nasal mucous membrane, pneumonic nuclei and caverns in the lungs. Fifteen horses had the passive form of the disease.

In some of the groups assembled over longer periods of time in the PKM, Milovzorov and Glukhov discovered horses with obvious clinical symptoms of glanders, out of which number many horses showed biological reactions. One of the sub-groups of the obviously infected horses had 17.3 percent reacting positively to CFT, and 43.7 percent reacting positively to CFT after malleinnization. Thus, not counting 7 cases of obvious glanders, at least 50 percent of the horses were afflicted with active glanders.

In another group, with no obvious cases of glanders at all, there were only 2.27 percent reacting to CFT, and 21 percent reacting to CFT after malleinnization. In this group, the number of cases with active forms of the disease is much smaller than in the first one, but still considerable.

Horses assembled in the PKM, were studied with relation to the forms and stages of the glanders process, to their stability to re-infection and super-infection, and to the degree of danger they constituted to each other as predicated on the respective stages of the glanderous process they were suffering from.

Karpenko was the first one to summarize the experiences in this field. His conclusions are as follows:

1. Horses with lost biological reactions or, with only positive reactions to mallein, can easily be reinfected through the alimentary

route, through contact with bacilli carriers, and through sub-cutaneous contamination with glanders bacilliculture.

2. The course of the new infection is easier in the case of malleinnic horses, than it is in the case of healthy ones, or those who lost the reaction to the mallein test. It is manifested by periodical temperature rises, the appearance of complement fixation substances, and the formation of new glanders lesions in organs and tissues.

3. PKM horses undergoing an active process of glanders cause the appearance in a considerable number of horses of the positive reaction to the complement fixation test (CFT), which is the result of re-infection.

4. The timely and thorough segregation and quarantining of all horses in the PKM, afflicted with the active forms of glanders, makes for a considerable reduction in secondary infections.

The cluster-like propagation of the active forms of glanders within individual groups of malleinnic horses, according to Milovzorov and Olukhov, is due to the fact that "into the above individual groups may inadvertently come several, or even only one horse, with or without clinical symptoms, yet with considerable generation of glanders infection, as a result of which there will be a re-infection of horses in whom the disease was in its fading-out stage, or has practically faded out, with the secondary appearance of clinical symptoms, or the re-appearance of serological reactions."

They do not ascribe any particular significance to the exacerbation of the glanders process in the case of malleinnic horses. They do recommend the segregation, into a particular group, of the horses with a positive reaction to the complement fixation test, after the sub-cutaneous injection of mallein.

Conclusions drawn by Oleynik and Avramenko (1937) are somewhat at

variance with the above conclusions:

1. Malleinnic horses display stability to secondary infection to such a degree, that neither prolonged contact with horses reacting positively to the complement fixation test, and with obviously glanders-stricken horses, nor experimental contamination with moderate virus dosages, will cause the appearance in them of clinical symptoms of the disease.

The frequently observed clinical and, mainly, serological exacerbations of glanders, in the PKM's, are due, if not entirely, yet, in a prevailing number of cases, to the endogenic re-infection, which is promoted by various unfavorable resistance lowering factors.

Secondary infection is a factor of secondary importance.

3. Scientifically, it is not rational to quarantine the malleinnic horses from those reacting positively to the complement fixation test (CFT).

In his following work (dissertation, 1939) Oleynik is more careful. He writes, that "prolonged contact of horses reacting to CFT with horses reacting to mallein, affects little the frequency of glanders in the latter." On the third conclusion, as depicted above, he says nothing.

In summarizing the epizootological experience gained as a result of concentrating the malleinnic horses into separate groups /PKM/, and the study of the course of glanders within them, it is necessary to come to the following conclusions:

1. The concentration of malleinnic horses had great epizootological and economic significance for the entire country. It was instrumental in stopping the further propagation of glanders, and at the same time was preserving the working capacities of the horses involved.

2. The forms of the glanders process in malleinnic horses vary, and, although malleinnic horses show more stability to secondary infection, and to exacerbation of the process, nevertheless, re-infection and super-infection do take place. The veterinary and sanitary control in the PKM

must prevent the possibility of the infection being propagated by individual bacilli-generating horses.

3. The insignificant number of horses showing clinical symptoms during experimental exacerbations, or even the absence of clinical exacerbation, means only, that the malleinnic horses, being glanders chronics, show more stability to exacerbations and re-infections than horses, as yet, untouched by the disease.

THE BREEDING OF HEALTHY COLTS FROM MARES WITH BIOLOGICAL REACTIONS TO GLANDERS

At the time the idea of concentrating the malleinnic horses into PKM's was conceived, the problem of natural reproduction was not anticipated. In some groups, however, there was considerable foaling. It became necessary to devise measures making for a healthy breed and for the prevention of infection of the young.

Literary data, but more so direct experience, pointed to the fact that the foals were born healthy, and were only subsequently contaminated through contact with their mothers or other horses in the camp. A two-year period of observation by Glukhov and Volkov on considerable numbers of foals, confirmed the fact that there was not one case of inborn infection.

Against the epizootological background, in which the foals were bred, Glukhov and Volkov divided the PKM's into three groups:

In the first PKM group, the foals were maintained separately from the adult malleinnic horses, had separate stables, separate grazing in the summer, separate attendants, with feed delivered by oxen or trucks.

In the second PKM group, the foals were also maintained separately, but at times intermixed with the adult horses in grazing, in stalls, or in watering places. Feed was delivered by malleinnic horses, and the older foals were put to work in undisinfected harnesses previously used for adult horses.

In the third PKM group the foals were not separated at all, being fully maintained through common watering, feeding, and housing with the adult horses.

The yearlings in all the three groups were subject to observations and research by a complex method, which will be described below. Those infected with glanders were removed. Further observations and research continued. The results of sanitation measures are summarized in the table below.

Table 15. Data on the First Group of PKM's

PKM (camp)	1936 Percent investigated	1936 Percent infected	1937 Percent investigated	1937 Percent infected
No. 1	100	4.2	100	0
No. 2	100	10.8	100	0
No. 3	100	0	100	0

The results of the investigation in the first three camps prove, that, in the absence of contact with the adult mallelnnic horses, it is possible to sanitize the yearlings through a single-complex method.

Table 16. Data on the Second Group of PKM's

PKM (camp)	1936 Percent investigated	1936 Percent infected	1937 Percent investigated	1937 Percent infected
No. 4	100	2.3	100	6
No. 5	100	6.2	100	2.8
No. 6	100	10.1	100	3.4
No. 7	100	0	100	5.2
No. 8	100	16.3	100	3.3
No. 9	100	11.1	100	1.7

The above results show that in these cases, where the yearlings are in communication with the adult malleinnic horses, it is not possible to sanitize them through a single complex method. Even sporadic contact is sufficient for the propagation of infection.

In the third group the yearlings had common maintenance with the adult horses. It was not the prevailing procedure in all PKM's, that the adult horses were subjected every 3 months to clinical examinations and to investigations by biological reactions. Therefore, the stages of the glanders process in the malleinnic horses were diverse, and the degree of contamination of the yearlings was accordingly diverse.

Table 17. Data on the Third Group of PKM's

PKM (camp)	1936		1937	
	Percent investigated	Percent infected	Percent investigated	Percent infected
No. 10	100	12.9	100	0
No. 11	100	37.1	100	25
No. 12	100	29.4	100	10.8
No. 13	100	37.9	100	22
No. 14	100	29.2	100	63.6
No. 15	---	----	100	76

Table 17 shows that in some PKM's the percentage of contamination decreased somewhat during the second investigation. This the authors explain by the improvement in the veterinary and sanitary controls during the experimental period. With relation to PKM Number 14, the discrepancy is due to the fact, that the horses with a positive reaction to the complement fixation test were not quarantined in time. On 23 August, 1936, two adult horses came through with clear symptoms of glanders, and the percentage of infection of the yearlings correspondingly jumped to 63.6. In PKM Number 15, too, there were horses reacting positively to the com-

plement fixation test. During the last year, there were practically no clinical examinations or tests made. As a result, the investigation in July 1937, discovered 76 percent of the yearlings afflicted with glanders.

In 1937, the entire contingent of yearlings aged, from 6 months to 3 years, in the PKM, was investigated by the complex method. 93.9 percent did not react to any of the biological tests. If the young were bred in all the PKM's under the conditions they were bred in the first group of PKM's, there would have been only single cases of infection amongst them.

During the investigation of the yearlings in the PKM, about 30 percent of the adult horse contingent consisted of grown up yearlings, which were free from glanders infection. Thus, it can be concluded, that under the conditions prevailing in the PKM's it is perfectly possible to replenish the overall horse contingent by reproduction and breeding within the PKM's, which, in the final analysis, will result in the complete liquidation of glanders within the PKM's.

The two authors mentioned above developed a flow sheet for the breeding of healthy offspring, as follows:

1. For the obtaining of offspring, there are selected the finest in appearance specimen of reproducers, stallions and mares (with positive opthalmic reactions), which are then segregated and maintained in stables, with strictly individual stalls for each animal.

2. During the grazing period, the pregnant mares are to be grazed separately.

3. The offspring from mares, reacting to the mallein test, are maintained, until weaned, under the mothers, and separate from other horses.

4. The weaning of offspring to be at the age of from 4 to 5 months.

5. After weaning, the offspring are tested for the presence of glanders, subjected to sanitation treatment, and shifted into groups of healthy young offspring.

6. The breeding of the healthy offspring is to take place on isolated individual parcels of land, or farms. The farms populated by these healthy offspring are serviced exclusively by oxen and by older offspring.

7. The exploitation of the matured yearlings to take place only within the territories, where no contamination is present.

The examinations of pregnant mares and their offspring to be conducted as per procedure, depicted under the heading relating to the diagnostics of glanders in the young.

CHAPTER EIGHT

PROBLEMS OF IMMUNITY TO AND THE THERAPEUTICS OF GLANDERS

IMMUNITY

The problems of immunity to glanders are, as yet, inadequately developed.

The recovery of horses from the disease is possible. The process of recovery in most cases is a long one, but as to whether there is, after recovery, evolved a state of immunity, or how strong is this immunity, and of what duration, -- to this there is no direct answer.

Nocard and Buley observed a secondary affliction of horses recovered from the disease, andeven the evolution of ulcers on the scar tissues, exactly in the place of the old ulcers. Lyurs, Nocard and Vladimirov admit to only a temporary rise in stability. More decisively in favor of the evolution of an immunity are the opinions expressed by Konev, Dedyulin, Sakharov, Babes, and others, based on observed cases of natural recovery.

Supposedly, both these opinions are not adequately reinforced by facts. The chronic form of glanders lasts long, and there aren't yet to this day, and particularly there were not at the time of the above mentioned authors (the 1900's), any methods for the specific determination of the state of recovery from glanders. Glanders chronics and horses

fully recovered react differently to secondary infection: the first display stability, while the second are more susceptible.

The non-malignant course of the glanders process with a tendency to natural recovery, and the frequent course of the process without any clinical manifestations in the southern parts of Europe, Asia, Africa, and other southern lands, was ascribed by Zemmer, Nocard, Babes, Bonhomme, Vladimirov, and, after them, by Leurs, Balle, and others, to the fact that in those areas, due to the extensive propagation of the infection, there developed a race of horses with stability towards the disease.

Schuetz, who made a study of glanders in Germany, where its propagation was not too extensive, came into contact with the acute process of the disease, and was skeptical even to the possiblity of its having a chronic form, too. However, in one of his last descriptions, after having come in contact with glanders in some Russian prize horses (in 1918), he changed his opinion. He writes: "In Russian horses, during the latent period of the disease, there are present two obstacles to secondary infection: race, immunity, and acquired immunity."

Drawing an analogy between glanders and tuberculosis, he allows for the existence of non-sterile immunity in the case of glanders.

Thus, Schuetz acknowledged the possiblity of an organism acquiring individual immunity and evolving inborn race immunity.

Extensive research relating to the development of individual immunity was done in the Soviet Union by Karpenko, Milovzorov, Glukhov, Oleynik, and Avramenko. They studied the susceptibility to secondary infection of horses belonging to the malleinnic groups, that is horses afflicted with chronic glanders, in various stable compensation stages of the process. Karpenko came to the conclusion that lingering chronics are subject to relapses. The secondary affliction is manifested by a rise in temperature, the appearance of antibodies, and by the intensification of the allergy reaction, the formation of new lesions and ulcers in the

trachea. No external manifestations are observed.

Prolonged contact of horses reacting to the mallein test with horses reacting to the CFT, according to Oleynik and Avramenko, did not produce, in the first, the exacerbation of the glanders process. Six horses reacting to the mallein test were in contact with four obviously stricken horses over a period of 2 months, resulting in a temperature rise and the appearance of serological reactions on the part of the six horses. These results were in agreement with those obtained by Karpenko. The horses were not subjected to autopsies, so that the processes, if any, taking place internally, remained unknown.

In injecting malleinnic horses with a glanders culture, depending on the dosage (2, 3, or 5 hundred million, or a billion microbes), the process of glanders would develop. In response to small doses of the culture, the process manifested itself by a local, general organic, and temperature reaction, and the appearance of anti-bodies in the blood. Swellings and ulcers appeared where the injections were made. The organic reaction was manifested by a state of general depression over a period of 2 - 3 weeks. Large doses of the virus (1 billion) were producing typical clinical manifestations of the disease.

It follows from this that horses afflicted with chronic glanders display more stability in the case of secondary infection. The course of the evolving /secondary/ process shows a trend towards fading out, and only when large doses of the microbe culture are injected, there will be external clinical manifestations.

When sub-cutaneous cellular tissue is contaminated with the glanders culture, there is formation at the injection spot of a diffused swelling, the size of a palm, very painful and inflamed. Khoromanskiy, Oleynik and Avramenko at times observed the development of ulcers.

The Japanese scientists Tojoda, Kunitake, Tsuru, in effecting contaminations with substance taken from glanders nuclei, observed the development of primary ulcers at the injection spots.

When the contamination was made with small doses of culture (only 3-4 times the minimum), there were no localized manifestations, and the secondary infections had no effect upon the further course of the disease.

Little is known about the toxic properties of the glanders microbe. Finger and Babes injected a prepared glanders microbe toxin into small laboratory animals, resulting in spasms, paralysis, and the appearance of edema at the injection spot. The glanders microbes generate toxic substances, of the endotoxin type, in the bodies of stricken animals. These endotoxins induce proliferous and alterative processes around the multiplying microbes.

The toxic substances also induce high fever, emaciation and exhaustion, or a general state of cachexia, which frequently is not directly connected with the degree of change in the /affected/ organs. To counteract the toxins, the organism develops neutralizing substances. With good maintenance conditions, the body of the stricken horse remains in good shape, as was observed in the case of isolated horses receiving adequate amounts of hay and oats. In cases where the stricken horse was short on food or long on work, general emaciation set in.

Glanders microbes, settling in the lymphatic nodes, in the lungs and other organs, induce a mild reaction, as follows: the microbes become surrounded by lymphoidal cells - macrophages, evolved from the local connecting tissue cells and the endothelium of the /lymphatic/ vessels, and microphages. As a result of this, there takes place the formation of the so-called glanders lesion. The microphage and macrophage ingest the microbe, but are unable to destroy it completely. Giant cells are formed, but they, too, are unable to destroy the microbe. The formed cells are subject to necrosis. The lymphoidal cells concentrating around the nucleus in ever increasing numbers, are transformed into connecting tissue cells, and the lesion becomes surrounded by a connecting tissue capsule.

The rapid and vigorous formation of capsules is, in essence, the defensive reaction of the organism against the microbe. If the organism is capable of evolving vigorous capsules, it will recover. If not, the disease will make further inroads. Around the nuclei are formed diffused infiltrates. The microbes, in their propagation, penetrate into the lymphatic and blood vessels, and are carried by the lymph or blood into various organs, establishing there new nuclei.

Within the incapsulated lesions the microbes are frequently found still alive, but with the calcification of the lesions they gradually perish. Calcification is the further defensive reaction of the organism [against the disease].

Thus, at the base of the organism's defensive reaction against the glanders microbe is not as much phagocytosis, or the humoral reaction, as the immobilization of the microbe by the formation of connecting tissue with the subsequent calcification of the pathological nucleus.

However, the effect of the phagocytoidal and humoral reactions of the organism upon the microbe is not to be completely discounted. Observations are on record, where the glanders process runs its course, without leaving any traces in the form of anatomical lesions. It is possible that such infections were caused by attenuated microbes, or the affected organism had a high degree of resistance, meaning vigorous phagocytoidal and humoral reactions. In these cases the intruding microbes are destroyed completely. There is no direct proof of the bactericidal properties of the anti-glanders serum. There is only one observation by Vladimirov to the effect, that in the exudate from a glanders swelling, subsequent to a sub-cutaneous injection of mallein, bactericidal substances were found.

The glanders microbe does not belong to the group of aggressive microbes, and only on extremely rare occasions is it found in the blood of horses. The microbe is in the blood for a very short time only, when

a nucleus is carried into a blood vessel, or when the process is extremely vigorous, and that in the case of cats and asses only, in whom the process of glanders is very acute, particularly in cats, where it is accompanied by septicemia.

IMMUNIZATION AGAINST GLANDERS

Attempts at immunization against glanders were based on some individual observations of phenomena relating to the interaction of the microbe and the affected organism, and were, therefore, empirical in character.

Already in the 1850's (1848) Baage and Techerning, in their diagnostical studies of glanders by auto-inoculation of the nasal exudate, noticed, that it resulted in rapidly-healing ulcers on the skin and on the mucous membranes, or in no external manifestations at all. They concluded then, that this could be the method of cure.

Great confusion into the problem of immunization was introduced by scientists, experimenting with various types of animals having diverse susceptibilities to glanders. Upon obtaining various types of results from their experiments, they considered them, by implication, as applicable to the organism of the horse, which was not the case.

ACTIVE IMMUNIZATION

All biological compounds, that were used for purposes of immunization against glanders, can be divided into: (1) virulent microbe preparations; (2) attenuated microbe preparations; (3) dead microbe preparations; (4) microbe metabolyte preparations.

Immunization with Virulent Microbe Preparations

The use of virulent microbes was the first experiment in immunization. Straus (1889) introduced, intravenously into horses, an insignificant amount of glanders microbes, preventing them thereby from falling prey to lethal affliction (with a secondary intravenous introduction of a considerable amount of microbes). However, the immunity obtained was only partial, and a case of chronic glanders followed.

The same result, and even full stability, was obtained on guinea pigs, by Nicolle.

Immunization with Attenuated Microbe Preparations

Much more numerous are the attempts at immunization with attenuated microbe compounds. Naturally attenuated microbes, or microbes specially attenuated for the experiment, were used. The experiment with naturally attenuated microbes was made by Vyshelesskiy, with negative results. The most extensive experiments in the past (1912) were conducted by Konev at the Velikoknyazheskaya Anti-Glanders Experimental Station. Konev prepared three glanders vaccines, two of which became well known. The first vaccine was an agar culture, a mixture of various stem-shaped bacteria, attenuated by 300 successive reproductions. The second vaccine followed the same bacterial procedure, except that it was a potato culture. The third vaccine was a bouillon culture. It was established experimentally that immunization leads to higher stability, but the immunized horses were afflicted with mild chronic glanders.

The results of some experiments conducted by Dodyulin at the Kharkov Veterinary Institute, were identical with the above. Vyshelesskiy repeated these experiments on many yearlings and adult horses in 1923-1924, at GIEV /State Experimental Veterinarian Institute/. Vaccinations were made by using the Konev vaccine Number 2, introduced into the body by rubbing into a shaved section of the skin, or by administering with drinking water, with a subsequent check on degree of resultant immunity, contamination by a virulent virus, also through rubbing into skin or drinking-water.

The results were as follows. The horses immunized by the first vaccine, or the attenuated virus, are frequently infected with mild glanders. The subsequent contamination of thus immunized horses with the virulent virus does not usually cause death. The ulcers at the place of injection were healing, and the yearling did not show any deviations from standard. The immunization did not prevent from secondary natural

contamination, as proved by the fact that all yearlings were afflicted after a period of from 3 weeks to 2 months of common feeding and watering with horses obviously stricken by nasal or skin glanders.

Some individual scientists attempted to attenuate the microbe proper by various other methods. Sakharov attenuated the microbe by passing it through cats, Khoromanskiy by passing it through pigeons, Klein with cow liver bile. Nicolle, after passing the microbe through guinea pigs, in the form of a Marten bouillon culture, prepared in soldered tubes, obtained a stable attenuated culture, which, in his opinion, was imparting a 70 percent immunity to all experimental animals. He also had an additional approach to the problem of attenuating the microbe. He was mixing the above culture with serums obtained from various animals, and introducing the mixture sub-cutaneously. It resulted in local, rapidly healing lesions. In order of effectiveness, the serums lined up as follows: Those obtained from a rabbit, guinea pig, cow, dog, and horse.

In 1927-1928 several last attempts to obtain a glanders vaccine were made. At the State Experimental Veterinarian Institute, the microbe was attenuated with aniline dyes. At the VVNII [All-Union Institute for Veterinarian Research], the glanders culture was attenuated by reproductions in bouillon with potassium bichromate. The first reproductions, instead of being attenuated, were, in fact, more virulent, killing the cat in 3 or 4 days, instead of the usual 12-day period. The thirteenth reproduction was the first to show attenuation. The 18th reproduction did not induce the disease in a cat. Three horses, immunized with this culture, showed high resistance to conventional contamination, resulting, in 2 cases, in single lesions, and in the third case, in no manifestations. The symptoms of the carrier horse integrated into a general case of glanders of the internal organs and skin.

Immunization with Dead Microbe Preparations

There were many diverse methods for killing the microbes. Sadovskiy was using moderate heat. One of the 4 immunized cats, and one yearling

(horse) withstood the control contamination. Klein, in using this procedure, obtained a negative result, Finger safeguarded the rabbits from the control contamination, and Sakharov succeeded in doing the same for guinea pigs, cats, and horses. Some time before his death, Selmetz repeated the tests of immunization with dead microbes, killed by high temperature. Upon obtaining a negative result, he advised other investigators not to pursue this procedure.

Out of all attempts at immunization with dead microbe preparations, the most successful were those by Marksar, Levi, and Blyumental'. They began with the premise that the failure of all the previous attempts at immunization by this method were due to the fact that the microbes, being killed in an abrupt manner, had their antigenic properties destroyed, and albumens coagulated. They used a mild acting compound containing 80 percent glycerine and 10 percent urea for the killing of the microbes. These preparations came to be known as farazy. The first step was to introduce them into the body intravenously, then, after 2 weeks, sub-cutaneously. Sometimes the sub-cutaneous injection was repeated after one month. The dosages were 0.1 and 0.2 for the first injection, and 0.2 and 0.4 for the second one. Three horses immunized with the glycerine preparation, turned up immune to the control contamination. Horses immunized with the urea preparation, showed less stability.

The Marksar preparation was checked in Russia by Makhotin and Bauts. Out of six immunized yearlings, all remained healthy after the control contamination. Two of these yearlings had their immunity checked after 14 months by contamination with a 0.001 mesh, the yearlings still remaining healthy. In 1910 Dedyulin immunized 1,000 horses, located in the estate Karlovka in Poltavskaya guberniya, with the same preparation, and obtained good results.

Borovskiy and Mikhin, after having tested this preparation (faraza), decided that it had no immunization properties. In the case of one horse,

it even caused a glanders infection. In 1915, Marksor himself obtained unsatisfactory results from this preparation, and, after much research, concluded that the antigenic properties of the faraza were lost due to the decomposition of the urea and the damaging action upon the microbes of the ammonia which was formed. The decomposition of the urea took place when the faraza was sterilized with running steam.

In 1918, Marksor, together with Leurs, Eberbeck, and Birbium, checked again into the immunization properties of the faraza. Immunized horses, together with non-immunized ones, were housed in stables, from which, directly before the experiment, glanders stricken horses were taken. The control horses developed glanders, while the immunized ones remained healthy.

Zurkan made a preparation, which he used with good results, and he called it maloaggresin [little agressin]. It is prepared as follows: Glanders bacteria are extracted in an 85 percent solution of salt, with 5 percent glycerine, and the preparation left to settle for 96 hours.

In 1936, Legru extracted [in solution] glanders bacteria in distilled water, and subjected the autolysate to the effect of 0.3 percent formalin, and heating to 60 degrees Centigrade. He called this preparation ANAMORV. ANAMORV protected guinea pigs from contamination and cured the ones that were already contaminated.

Twelve horses with clinical symptoms of glanders were given 3 subcutaneous injections of ANAMORV in the amount of 1-3 cubic centimeters at 48-hour intervals; then rested for 8 days, and injections repeated. Within 6 weeks, the clinical symptoms of the disease disappeared.

Immunization with Microbe Metabolyte Preparations

Preparations in this category were not numerous. Sakharov proposed the use of a microbe filtrate. Nicolle and Fruen experimented with aminobases obtained from the glanders microbe albumen, with results negative.

Many attempted immunization with mallein. Out of these, Gel'man, Babes, and Zemar report favorably; Nocard, Ben, Vivald, Shindel'ka, Berovskiy, and Oskolkov, however, did not succeed in obtaining immunity.

Dedyulin and Bez'yazychnyy conducted unsuccessful immunization experiments with partial antigens. From bouillon cultures aged for several months, they extracted, with esters and alcohols, fatty substances, which they called glanders fat, and used it for immunization experiments.

Passive Immunization

The preparation of anti-glanders serums was undertaken several times, without arriving at positive results.

Many scientists, such as Chencon, Pic, Arukh, Petrini, Klein, attempted to induce stability and cure glanders with a serum obtained from cattle, with the thought that if the cattle themselves do not become afflicted with glanders, the serums obtained from them must contain bactericidal substances. In Russia, these experiments were conducted at the Khar'kov Veterinary Institute by Mal'tsev. Sulin obtained serum from dogs. At the Velikoknyazheskaya Anti-Glanders Experimental Station, they were immunizing horses with glanders cultures. There was also in use a serum prepared by Nonevich.

In America, Watson obtained a serum from a horse after immunizing it with mallein. Three afflicted humans were cured by the use of this serum. The check experiments by Vyshelesskiy in the immunization of horses, with the serum prepared according to Watson, gave unsatisfactory results. In 1927 hopes were concentrated on a serum prepared by Kolpikov. He immunized a cow with glanders cultures, and obtained a serum powerful enough to cure afflicted cats and even impart immunity to the kittens, born to the immunized cats. Check experiments conducted together with Kolpikov, did not yield any satisfactory results. The same failure resulted from the experiments at the All-Union Veterinarian Experimental Institute con-

ducted by Gazarkh.

With relation to all sorts of immunizations attempted up to 1913, Vladimirov wrote: "Durable immunity in cases of artificial contamination, as well as in cases of artificial immunization by preparations known at the time, is not observed."

THE THERAPEUTICS OF GLANDERS

The same difficulties beset the problems of the therapy of glanders as do the problems of immunization.

Abroad, attempts at curing the disease of glanders were made only in the 1890's. Following that, the struggle was conducted simply by way of destroying the stricken animals. Subsequently, the therapy of glanders was being developed by physicians, mainly for the purposes of curing afflicted humans.

By analogy with the therapy of tuberculosis by the use of tuberculin, Gel'man, Zemmer, Ione, Khoromanskiy, Pilarios, Zichev, and Papsku attempted to cure glanders in horses with mallein. In individual cases results were good, but, since it was known that glanders in horses is subject to spontaneous recovery, it was never definitely established, whether said recovery was really due to the effect of mallein. Mallein therapy requires precise dosages in each individual case, lest an exacerbation of the process result in place of a cure. In addition to that, mallein therapy requires long periods of time, and, therefore, is of no practical value.

Therapeutical methods used on humans were rather varied. Zieler treated limited nuclei of the disease surgically. Golmes, Buchke and Remy also resorted to surgery, with Leurs passing an opinion that the recovery might have been spontaneous. Wiemann cured a veterinarian by amputating an infected finger. Grayevskiy, Gold and Kondorskiy treated human glanders with mercury and iodine. Zieler believes that mercury treatment is

effective in localized processes only, but is of no use otherwise. Zieler and Kerning observed a reduction in fever and improved general feeling, without affecting the process itself, after prolonged mercury and potassium iodide treatment. Hallopeau and Leanselme treated a patient for a period of 6 months by introducing 700.0 [illegible] of potassium iodide without any favorable results.

Later on, Genzmer, who used iodine and its compounds, did not obtain complete recovery. On the other hand, Monert observed complete recovery in one case. Kranz reported good results with the Fowler solution. Iohnes cured a case of nasal glanders in his son by spraying the affected area with a solution of creosote. Zieler obtained good results with salvarsan, while Zabolotniy reported negative results from the use of same, as well as from the use of Bayer 205 and kupfersalvarsan.

In addition to chemical preparations, therapists attempted to cure human glanders with biological preparations.

Bon reported on the favorable effect of mallein, while Zieler observed the exacerbation of the process from the use of same. Zieler obtained good results with a vaccine, prepared as follows: one cluster of a 48-hour agar culture per one cubic centimeter of physiological solution with 0.5 percent phenol to be heated at 60 degrees Centigrade for 1 hour. The dosage to be from 1/10 to 3/4 of the cluster, repeated 5 times during a period of 4 weeks; two more injections of $\frac{1}{4}$ to $\frac{1}{2}$ of the cluster after an interval of several weeks. Fischer obtained good results in curing humans by using the above mentioned faraza. He reports negative results from the use of neo-salvarsan, which, incidentally, requires great caution in dosing.

Missner and Lange made 8 unsuccessful attempts at curing horses with salvarsan and neo-salvarsan. One such attempt by Frank also resulted in failure.

The many therapeutical experiments made with salvarsan are due to the fact that Benevolenskiy established its high bactericidal properties with relation to the glanders microbe in the test tube. He succeeded in effecting the cure of 7 contaminated rabbits out of a total number of 15. Six control rabbits and 8 rabbits that underwent the cure, died. Meshkov used salvarsan successfully on one horse. Blagodetelev and Goryachev were also successful with it. Korsaun, Borovskiy, Gordzyalkovskiy, Volodskiy also produced favorable, albeit not such clear, results.

During World War I (1914-1918) in Germany, Leurs, Birbaum, and Eberbeck experimented on a large scale with preparations from mercury, salvarsan in many modifications, also various serums and bacterial preparations. The results were such, that Leurs could not point to any of the preparations as having definite therapeutic value.

CHAPTER NINE

ORGANIZATION OF THE ANTI-GLANDERS CAMPAIGN IN THE USSR

CAMPAIGN SCHEDULES

From data presented in Chapter One, it was possible to form an idea as to the deficiencies pertaining to the organization of counter-measures against glanders in the former Russian empire. With the establishment of Soviet power, the civil war to the contrary notwithstanding, the struggle against the disease assumed new and more definite forms.

It is natural that the struggle against glanders began in the army. One of the very first steps of the Military Veterinarian Administration was an order effecting the reorganization of the Laboratory of the Northwestern Front into the Central Veterinarian and Bacteriological Laboratory of the GVVU /State Military Veterinarian Administration/.

The laboratory was moved from Smolensk to Moscow in 1918. Since the production of mallein at the Institute of Experimental Medicine was

discontinued, the laboratory undertook this activity, along with the conducting of serological and diagnostical research, and the graduation of physicians-veterinarians for the bacteriological and serological laboratories, also specialists-epizootologists.

Subsequently, many laboratory specialists were transferred to Civilian Administration, where they served as the basic cadre of the serological personnel.

First Schedule. In 1918, the ophthalmo-malleinnic test and the complement fixation test [CFT] were authorized as the official biological methods in the diagnostics of glanders. At the same time Ruzhentsev developed the first schedule for the combatting of the disease. It was based on modern methods and came to be known as the Professor Ruzhentsev Schedule.

The basic premise of this schedule was, that only horses free from glanders could be assigned to the Red Army. This made it compulsory for all horses slated for the army to be subjected to the ophthalmic test, with only the ones showing a negative reaction accepted.

The regular horses of troop detachments were made subject to monthly clinical examinations, narrowed down to weekly, with the appearance of glanders in the detachment. Obviously glanderous horses were subject to immediate destruction.

In a troop detachment, where glanders was present, all horses, in addition to clinical examinations, were subject to ophthalmo-malleinnization, at 2-week intervals, until the detachment was declared free of contamination.

By the results of the ophthalmo-malleinnic test, the horses were to be broken down into four groups:

Group I -- positive and doubtful reaction, with clinical symptoms not adequately pronounced.

Group II -- positive reaction, with clinical symptoms absent.

Group III -- doubtful reaction, with clinical symptoms absent.

Group IV -- negative reaction, with clinical symptoms absent.

The horses falling into the first three groups were to be additionally tested by the CFT, or, in case of great distance from a laboratory, or the impossiblity of delivering the blood to the laboratory, by sub-cutaneous injection of mallein.

If the reactions to the above tests were positive, the horses were to be destroyed immediately.

The horses falling into the first three groups were to be individually isolated, individually maintained, fed and watered.

The counter-measures undertaken in accordance with this schedule, which came to be known as rigid, assisted in the cleansing of the army horse contingent of considerable numbers of glanderous horses, and created the conditions for a shift to the so-called softer schedule introduced in 1924.

In 1921, at a convention of civilian veterinarian personnel, the Ruzhentsev Schedule for combatting glanders in the army was also authorized for civilian use, except that, at the time, the necessary prerequisites for its application were, as yet, non-existent.

Second Schedule. The basic premise of the schedule was identical with same in the first schedule.

1. All horses slated for the army are to undergo the mallein test by the replacement commissions. Only horses without any clinical symptoms and with a negative ophthalmic reaction are accepted. Upon arriving in the troop detachment, the horses are quarantined for a period of 3 weeks, during which period they undergo again the ophthalmo-malleinnic test and a blood analysis by the CFT.

2. All the horses of the detachment, irrespective of the presence or absence of glanders, get their blood tested by the CFT not less than once a year. Only the horses reacting to the CFT undergo malleinnization.

3. All veterinary counter-measures in the combatting of infectious diseases in general, and glanders in particular, shall be coordinated by the army with the civilian veterinary authorities. Army rejections shall include only horses showing negative ophthalmic and CFT reactions.

The basic difference between this schedule and the first one is that now the horses were mallein-tested twice before being accepted by the army, and, when in the army, were subject only to the CFT. However, horses that showed a positive, or a doubtful reaction to the CFT, were again to be tested with mallein. Generally speaking, mallein was to be used also at the discretion of the veterinary physician.

At this time, a part of the malleinnic horses, mostly from the older ranks, were still in the army, and it was rather a difficult problem to get rid of them. It was then decided to segregate all horses reacting to mallein, but without any clinical symptoms, and with a negative reaction to the CFT, into separate so-called malleinnic groups. These horses were not limited with relation to work, but were given individual maintenance, with systematic allergy and serological tests.

Before introducing the above procedure, all malleinnic groups were merged into one army combination contingent, located in the Ukraine in 1924. At the same time, the Glanders Department of the All-Union Veterinarian Experimental Institute, headed by Vyshelesskiy, was ordered to conduct studies pertaining to the immunity against the disease, to the stability of malleinnic horses to super-infection, and to the contamination of healthy horses through contact with malleinnic horses.

Observations established, that malleinnic horses are fully capable of normal work, the exacerbation of the process is observed very seldom, and, with individual maintenance, they do not constitute any danger to each other, or to the healthy horses. It was therefore decided to expand the organization of malleinnic groups.

Third Schedule. This schedule was introduced in 1927, and was as follows:

1. All horses slated for the army to be subject to tests, as per schedule two.

2. Every year, not less than once, as a matter of regular procedure, or when glanders appears, all horses to be tested by three methods: clinical examination, ophthalmo-malleinnic test, and a blood analysis by the CFT.

3. Horses with obvious clinical symptoms to be destroyed immediately, the remainder to be given the ophthalmic test and a blood test as per CFT.

4. Horses with clinical symptoms not well pronounced, but with positive ophthalmic reaction and positive CFT, to be destroyed.

5. Horses without clinical symptoms, but with positive or doubtful CFT, to be subject, after 15 days, to repeated tests by the same methods, and, in case of positive results, to be destroyed.

6. Horses with doubtful or contradictory reactions to tests, to be additionally tested.

7. Horses without clinical symptoms, with positive reactions to mallein and negative to CFT, to be separated into malleinnic groups.

8. Horses without clinical symptoms and with negative reactions to biological tests, to be left in their present assignments, but to be subject to monthly tests by all three methods, as depicted above, until detachment is declared free of contamination.

9. The declaration of a detachment to be free of contamination to take place 3 months after the occurrence of the last case of segregation and the subsequent disinfection.

STAGES IN THE STRUGGLE AGAINST GLANDERS

Success in the struggle against glanders was brought about by: (1) correct procedure in the application of counter-measures, and correct organizational and procedural leadership; (2) active participation of not only the veterinarian, but also the Red Army, commanding officer, and pol-

itical control personnel; (3) persistence in the application of counter-measures; (4) availability of high-grade diagnostical preparations, such as mallein, components for the CFT; also the availability of laboratories, with qualified epizootological and laboratory personnel; (5) scientific research and the application of its results in the counter-measures evolved.

In their struggle against the disease, the civilian authorities borrowed from the experience accumulated by the army, with relation to both scientific research and everyday procedure.

The struggle against the disease affecting the civilian horse population was on, primarily, in contaminated areas, and was conducted by partial mallein tests, and the destruction of obviously glanderous horses.

Only in 1925, was it decided to inaugurate a systematic anti-glanders campaign. The struggle was to be conducted in two stages. The first stage called for the determination of the overall degree of contamination of the entire horse population by clinical examinations and ophthalmo-malleinnic tests. All horses with obvious clinical symptoms, were to be destroyed. All horses reacting to mallein were to be registered, with special certificates assigned to each such horse.

All horses reacting to mallein were first segregated by each economy into special malleinnic brigades, and were later concentrated into special malleinnic economies, or PKM. In those places, where there were only individual cases of glanders, the first All-Russian Veterinarian Convention of 1926 was proposed, that no PKM's be established, but the malleinnic horses either be destroyed or taken to existing PKM's.

The second stage called for the complete eradication of glanders. In places where the disease was merely sporadic, the second stage coincided with the first one, since, with the diagnosis made, the few afflicted horses were either destroyed, or taken away to the PKM's.

Subsequently, in all these areas, through systematic, head-by-head,

clinical examinations and tests conducted annually, the attained freedom from contamination was reasserted and secured. Thus, at the present time, the disease of glanders is absent from the entire territory of the Soviet Union, with the exception of the few PKM's (points of concentration for malleinnic horses).

The horses assembled at the PKM's, were performing their normal assignments in agriculture. However, from time to time, serological and clinical exacerbations of the process would occur in some horses. Cases where biological reactions were lost, permanently or temporarily, were also observed. Then there were offspring, in numbers sufficient to acquire considerable economic significance.

All this posed, before the Veterinarian Administration and its research institutions, a series of problems calling for additional methods and means directed towards the cleansing of the PKM's of all horses afflicted with the active form of glanders.

SCIENTIFIC INVESTIGATION AND RESEARCH

The scientific investigation and research work was charged to the Novocherkassk Veterinarian and Prophylactic Institute. The first thesis published by the Institute, was Karpenko's "study on the problem of reinfection of malleinnic horses in the presence of glanders." The object of this thesis was to arrive at the answers as to the degree of danger constituted by the malleinnic horses, and as to the veterinary and sanitary control under which they are maintained. Oleynik and Avramenko were working with the same end in view.

In his next thesis, "The study of malleinnic horses as bacilli carriers, and its significance in combatting the disease under conditions of agricultural economics", Karpenko elaborates upon the problems analyzed in his first thesis.

The first thesis develops experimentally the problems of susceptibility and stability of malleinnic horses to secondary infection, through

contact with the discharges of afflicted horses and with microbe cultures introduced alimentarily or sub-cutaneously.

In the second thesis, Karpenko is occupied with the problem of diagnosing the active cases of glanders, for the purpose of separating them from the malleinnic groups, and also with the general epizootological value of the PKM's. His sixth conclusion is as follows: insofar as amongst horses reacting positively to mallein, there are always present bacilli-carriers and bacilli-generators, the danger of diffusing the infection is always present, when malleinnic horses are in contact with healthy ones. Therefore, the now prevailing practice of concentrating the malleinnic horses in PKM's is to be considered a very rational one. Furthermore, with the maintenance of a thorough veterinary and sanitary control, the PKM's certainly cannot become the source of further propagation of the disease. As to the final sanitation of the PKM horses, Karpenko recommends the application of the Angora method.

Since at this time (1930-1935) chronic glanders was the prevailing form taken by the disease, the ophthalmo-malleinnic test was producing confusing results. The reaction frequently shifted from positive to negative, or altogether disappeared, all in the same horse. It became necessary to reexamine the conditions under which the ophthalmo-malleinnic tests were administered, in order to rapidly cleanse the horse contingents of all the chronic cases of glanders. This was accomplished by Milovzorov and Glukhov, and published in their thesis, "The sensitivity of the ophthalmo-malleinnic test as related to the mallein activity, to the stage of the glanders process, and to the sensibilization of the conjunctiva of the eye." The above two also developed their own method of provocation by the injection of a dead glanders microbe culture.

This problem was also the concern of a special commission of the Veterinary Administration at the People's Commissariat of Health, USSR.

Thus, the PKM's were cleansed of horses afflicted with active glanders.

By this time, there appeared cases of glanders amongst the yearlings born from malleinnic mothers. Experience showed that the diagnostic reactions of the young are very irregular, the segregation of the stricken yearlings is hard to accomplish, making the struggle against the disease in this group very unsuccessful. A complete study of the run of diagnostical reactions in the yearlings, and the development of a method assuring specific diagnosis, were called for. This was accomplished by Milovzorov and Gluchov, and, later, by Karpenko and Volkov, by introducing the complex method, i.e. the ophthalmic reaction, sub-cutaneous reaction, and a blood analysis by the CFT, prior to and after the sub-cutaneous malleinization.

By using this method, Karpenko and Volkov, successfully sanitized many yearling contingents, creating thereby the possibility for the liquidation of glanders in the PKM's by the use of internal resources alone.

By this time, there is in many PKM's the contingent of healthy matured yearlings, the offspring of malleinnic mothers, can be seen taking the places of older malleinnic horses, which are gradually eliminated, either by natural death or by planned destruction. The time is not far off when there will be no more malleinnic horses in the PKM's, and there will be no more glanders in the Soviet Union.

The experience gained in the actual struggle against the disease, and the results of scientific investigation and research, made it possible to devise an orderly system of counter-measures.

As in the cases of other infectious diseases, these counter-measures are divided into prophylactic and compulsory.

One of the basic prophylactic steps is the compulsory allergy test to be administered to the entire horse contingent, and to other whole-hoofed livestock, not less than once a year. During the past and present stages of the anti-glanders campaign, this step proved to be one of the most effective.

From previous text, it is known that cases of chronic glanders are difficult to diagnose, and the segregation of chronics takes place over a number of years. Milovzorov and Glukhov established that a two-time malleinnization at an interval of 5-6 days, considerably accelerates the battle for the liquidation of the disease. Therefore, it was incorporated into the instruction, that in all locations where, during the last two years, there were no registered cases of glanders, it is necessary to administer one mallein test every year, before shifting the horses to stall maintenance, while in contaminated locations, a two-time ophthalmo-malleinnic test, at an interval of 5-6 days, is mandatory.

In following up this counter-measure, it becomes necessary to decide: (1) for how long a period to sustain the two-time malleinnization, and (2) is it necessary to continue with malleinnization in non-contaminated economies?

The answer to these two questions, in our opinion, should be given in the light of epizootological conditions with relation to glanders in the given economy and its surrounding area. It is but natural, that during the process of liquidation of the disease in an economy, diagnostical practice must employ the more sensitive method, that is, two-time malleinnization, in order to segregate and remove all horses suffering from the chronical form of glanders. This will take about 2-3 years. Subsequently, for 2-3 more years, one-time malleinnization should be employed, after which period it is rational to discontinue the annual malleinnizations. However, the final decision will depend to a considerable degree on the actual state of non-contamination in the entire surrounding area, such as region or territory.

/As it looks/, it will rather become possible to discontinue research in the northern and central belts of the Union, where no glanders has been registered for many years. More vigilance is called for in the areas of previous propagation of stationary glanders, and in the areas

where PKM's are located. It will also be necessary to take into consideration the shifting of horses from place to place. The discontinuance of counter-measures is possible sooner in economies with permanent horse contingents than in those maintained by replacements. Conditions under which the horses are maintained, whether in stables or in herds, and the availability of qualified veterinary and sanitary control, are important factors to consider. All of the above must be taken into account, before arriving at the decision to discontinue annual malleinnization. It is clear, that such decisions, embracing the entire Union, cannot be made all at once.

With respect to these counter-measures and, particularly, with respect to the correct evaluation of the state of sanitary non-contamination of entire zones and regions of the Union, attention must be called to the differential diagnostics of the positive and doubtful reactions to the ophthalmo-malleinnic tests, obtained during the annual malleinnizations. Malleinnization, as well as any other biological method of diagnosis, is subject to error, amounting on the average to 5 percent. The horses involved in this diagnostical error, are, within existing conditions, relegated to the malleinnic group, with all the consequences flowing from such classification. It is not the fate of one horse, but the correct evaluation of the epizootological state with relation to glanders, pertaining to the horse contingent of not only a single economy, but of entire areas, that is at stake.

We, therefore, propose that the time is here to investigate all horses showing positive and doubtful reactions to ophthalmo-malleinnic tests, by using all the available methods as described above, before clamping down the diagnosis: chronic glanders - malleinnic horse.

PROPHYLACTIC AND COMPULSORY COUNTER-MEASURES FOR THE COMBATTING OF GLANDERS

Horses arriving into economies are to be subject to a 20-day quaran-

tine and to ~~two-time~~ ophthalmo-malleinnization. The quarantine period is of tremendous epizootological importance, not only with relation to glanders, but also as a safeguard against other infections, and must, under all conditions, be strictly adhered to.

Horses showing positive and doubtful reactions in head by head investigations, or at the time of arrival into an economy, must immediately have their blood examined by the CFT, and, in case of positive results, be destroyed immediately. Horses with only one positive ophthalmic reaction must be shifted into PKM's, or if very few in number, they should be destroyed, under the authority of the regional Soviet representing the laboring masses, since they may become dangerous carriers.

Annual prophylactic disinfections of installations and harnesses, the individual assignment of a harness and other objects of horse maintenance, individual watering and feeding, individual drinking pails during excursions, assignment of individual maintenance men, veterinary and sanitary education of all servicing personnel, regular veterinary and sanitary inspections and biological tests for all horses, outbound from the economy for considerable periods, to expositions or the like, prior to transportation by rail or water, -- all these are basic prophylactic counter-measures in the struggle against glanders.

The /date of/ malleinnization should be clearly indicated on the horse's passport and travel certificate. Horses returning from long leaves of absence, necessitated by various assignments outside the economy, shall be quarantined and subject to malleinnization.

Immediately upon the appearance of glanders in an economy, swift and systematic counter-measures should be applied. While the process of the disease is in its acute stages, it is a simple matter to segregate all the afflicted horses. Such is not the case when the process assumes a chronic course. As seen from previous text, the /effective/ segregation of glanders chronics may take up a period of several years. Therefore, as soon as glanders appears in an economy, an anti-glanders commission

is to be organized, a clinical examination of all horses with previous ophthalmo-malleinization is to be undertaken, and a series of other restrictive counter-measures is to be introduced.

Through a series of clinical examinations, ophthalmo-malleinization and blood analysis by the CFT, as per /official/ instructions, with intervals of from two to three weeks, the economy can be freed from glanders after three or four series of investigations, provided the disease was introduced into the economy recently.

Horses obviously glanderous are destroyed immediately. Horses with indefinite clinical symptoms, but with positive ophthalmic reaction, and a positive CFT, are also destroyed. Horses without clinical symptoms, but reacting to the ophthalmic test and to the CFT, are destroyed after two investigations. Horses reacting to ophthalmo-malleinization only, are considered to be malleinic horses. Since, in economies where contamination is of recent origin, the chronical form of the disease is not present, the discovered malleinic horses may be either just at the beginning of the glanders process, or afflicted with a very mild case of it. In such malleinic horses, glanders will not take the form of a stabilized compensated process, and, therefore, the /approach to the problem posed by these horses/ should be a very cautious one.

The horses segregated by clinical symptoms or diagnostical reactions must be isolated into separate categories. Horses with clinical symptoms not clearly pronounced, but with positive biological reactions (category I), go into the first department of the glanders isolator. Horses without clinical symptoms, but with positive reactions (category II), go into the second department of the glanders isolator, to remain there until the end of the investigation. If, at the end of the investigation, they are pronounced healthy, they are released. When the contrary is the case, they are destroyed.

Horses, reacting to mallein only, are also separated from all other horses into special stables, serviced by special personnel. The horses are shifted to individual feeding and watering until such time as transferred to PKM or destroyed. Until their transfer to PKM, the horses may be worked in specially assigned areas, where they cannot come in contact with healthy horses. They certainly are not to be assigned to the transportation of fodder and hay, or to common grazing in the meadows.

The destruction of glanderous horses is effected by a bloodless method, either by a blow on the forehead struck with a heavy forging sledge, or the injection of strychnine into the lungs. No autopsies are performed, the hides are not removed, except that they are spoiled by burning prior to burial. The procedure is as follows: mazut [petroleum residue] or kerosene is poured over the corpse in the pit, deadwood is thrown over it, with some more petroleum residue or kerosene added (altogether 2-3 liters), and fire set to it. The corpses are buried in cattle cemeteries, or thrown into a Bekkari pit.

As to the arrangement of glanders isolators, see instruction.

The commission, after establishing the degree of propagation of glanders, with the aid of clinical examinations and ophthalmo-malleinnization, determines the number of horses subject to quarantining. In doing this, the commission is to be guided by considerations as to the possibilities of glanders still being present in the said group. Therefore, horses who were housed in common, watered in common, or maintained in a common herd, or groups of horses, that came in contact with each other at work, or in grazing, are to be quarantined accordingly.

The quarantined groups are divided into 3 categories: category I - obviously glanderous horses, subject to immediate destruction; category II - suspected of being glanderous; category III - suspected of contamination. All these categories are investigated, as per previous text. The economy, where all this takes place, is declared contaminated and is

quarantined, as a whole, until such time as it has within its boundaries afflicted horses, and two months after the last glanderous horse was destroyed, or the last malleinnic horse taken away. During this entire period, all horses are to be constantly investigated, as per official instuctions. The last three reactions to the last three ophthalmo-malleinnic tests must be negative.

Prior to the final lifting of the quarantine, there is to take place the final disinfection of buildings and enclosures.

Limitations for quarantined economies were not anticipated in the active instruction of 1933. We maintain, however, that until the quarantine has been lifted and the full sanitizing of the economy accomplished, no horses are to be slaughtered for meat, and no koumiss is to be made from the milk of mares. The removal of horses from the economy, as well as objects and materials used in their maintenance; the bringing in, or even the coming through, in transit, of healthy horses, is forbidden, until such time as the quarantine is lifted from over the economy.

We maintain, that grain and forage in bulk may be taken from quarantined economies and PKH's under the following conditions: (1) when the grain and forage are gathered in by mechanized power, oxen, ~~by~~ human hands, or horses unquestionably healthy; (2) when grain for sowing and technical purposes is gathered in by horses reacting to mallein. It must be remembered, however, that the leavings from the sorting of the above may be used as feed only for such animals as are non-susceptible to glanders. The shipping of grain and hay may be done by truck, oxen and horses known to be healthy.

Manure from the horses belonging to category III must be subjected to a two-month bio-thermical decontamination, after which it can be used in the fields. The hides from horses in category III, which perished from other diseases, and who, prior to their death, showed no less than two negative ophthalmic reactions, at an interval of 2-3 weeks, may be removed

/for use/. The tails and manes of horses in the same category, after 2-3 consecutively negative ophthalmic reactions, may be shorn /for use/. Enclosures, such as day quarters, stalls, etc., that were occupied by stricken horses, and two adjacent stalls, to the right and to the left, to be subject to scrubbing and disinfection, as per direction of the veterinary doctor, and under the observation of the veterinary control, immediately upon the removal of the infected horses, or the corpses of those that perished from the disease.

The cleaning and disinfection of enclosures to proceed as follows:

1. Manure, litter, and remnants of feed from under stricken horses, after preliminary disinfection with milk of lime (10 percent), is hauled away to a specially designated place and burned, or buried to a depth of no less than one meter. The remaining manure of the stable is to be subjected to a two-month bio-thermical treatment, after which it can be utilized in the same economy.

2. Walls, partitions, posts, doors, etc., of the stable, are to be scrubbed and washed with a hot 3 percent solution of caustic soda or hot strong ash-containing lye.

3. Floors, after moistening with a 3 percent solution of creolin and scrubbing, are liberally flooded with a 10 percent solution of freshly slaked lime or a 10 percent solution of calcium hypochlorite.

4. The entire stable to be whitewashed with milk of lime.

5. All maintenance articles located within the structures, as well as feeding and drinking devices, to be disinfected as follows:

(a) Metallic articles, such as spades, forks, rakes, chains, etc., to be burned off by fire, or, when of small size, to be dipped into a 3 percent solution of phenol, or a 3 percent solution of creolin for 30 minutes. Pails are to be disinfected with a 3 percent caustic alkaline solution, or hot ash containing lye, with subsequent rinsing with water.

(b) Wooden articles, also wagons and sleds -- with a soap-and-

phenol solution, or a 5 percent phenol solution -- by spraying until thoroughly wet.

(c) Yokes, saddles, and saddle pads -- by wiping the leather parts with a 3 percent solution of creolin and subsequent rinsing with clean water, drying in the shade and covering with tar. The felt parts to be disinfected by pulverization spraying with a 3 percent phenol solution until thoroughly wet, subsequent drying in the sun, after the leather parts were covered with tar.

(d) Leather bridles, shoulder bands, and reins to be thoroughly wiped with a 3 percent solution of creolin, then rinsed with water, dried in the shade and covered with tar.

(e) Brushes to be dipped into a 3 percent solution of creolin and kept there for 10 minutes.

(f) Coveralls, towels, cloths, canvas gloves, to be thoroughly steeped in a 3 percent solution of creolin, or phenol for 30 minutes, then boiled in a solution of wood lye for 15-20 minutes.

(g) Leather boots and gloves to be disinfected the same way as the leather parts of yokes; rubber boots and overshoes to be washed with the same solutions (creolin, phenol).

(h) Articles of little value to be burned completely.

PROCEDURES TO BE FOLLOWED IN THE DIAGNOSTICS OF GLANDERS

Ophthalmic malleinnization. Mallein tests are to be administered by a veterinary surgeon or under his supervision by an assistant.

The ophthalmic malleinnization test is administered to the eye having a normal conjunctiva. When conjunctivitis or other eye disturbances are present, no ophthalmic test is to be attempted.

Malleinnization is administered twice to the same eye, at an interval of 5-6 days (as a rule, to the left eye). The mallein is applied in accordance with the biological laboratory instructions accompanying the package.

Ophthalmic malleinnization is effected by dropping onto the conjunctiva of the horse's eye 2-3 drops of mallein with the aid of a pipette. The pipette must be sterilized by boiling before using on each individual horse. The veterinarian's hands must be disinfected after each horse has been treated.

The reaction sets in with the second hour, usually with the third hour. With the sixth to eighth hour, the reaction is at its maximum. At times reactions are delayed, and begin to develop with the 12-14-20th hour, even later. The reaction lasts from 10 to 24 hours, sometimes only 2-3-4 hours. Therefore, the test is to be administered in the morning.

The local reaction in ophthalmic malleinnization manifests itself by epiphora, the reddening and swelling of the conjunctiva, and the appearance of a serous or purulent outflow from the inner corner of the respective eye. Depending on the degree of manifestations and the character of changes in the conjunctiva, the results of the reaction are differentiated as positive, doubtful, and negative (the absence of reaction).

Positive reaction. Purulent conjunctivitis of various degrees: the conjunctiva becomes red, swollen, there may be epiphora of various intensity, some swelling of the eyelid, and the closing of the eye. In the eyeball cavity, usually along the edge of the lower eyelid, appears a string of pus, descending at the inner corner of the eye. When the reaction is mild, pus is observed at the inner corner of the eye only.

Doubtful reaction. Reddening, some swelling of the conjunctiva and epiphora, discharge of a mucous secretion.

Negative reaction. Eye remains normal (no reaction at all).

In case of a repeat doubtful reaction, the horse is considered as having shown a positive reaction to mallein.

The course of the reaction is to be observed at 3-6-9-12 and 24 hours.

Sub-Cutaneous malleinnization. On the day preceding this test, the

the horse's temperature is taken 3 times, in the morning, at noon, and in the evening. From the separate readings, the mean temperature is computed. The injection is to be administered only to horses whose mean temperature on the previous day is not above 38.5 degrees Centigrade.

Horses observed as habitually feverish, are not to undergo a sub-cutaneous injection of mallein, if even one preliminary reading reaches 39.0 degrees Centigrade, also in case the horse already underwent a sub-cutaneous malleinnization up to one and a half months prior to this date.

The [sub-cutaneous] introduction of mallein is to be timed to the 23-24 hour, so that in the morning, six hours after the injection, temperature readings may be taken every 2 hours, ending with the 24th hour, and one additional reading to be taken after 36 hours.

The horse under test is not to work and, until its temperature begins to come down, it is not to have any water.

The mechanics of the sub-cutaneous malleinnization. The hair is shorn from the area of the neck or lower part of chest. The chosen spot is disinfected with a 5 percent water or alcohol solution of phenol, wiped dry. With the aid of a sterilized hypodermic needle, one cubic centimeter of mallein is injected into the sub-cutaneous cellular tissue. The hypodermic needle is to be sterilized by boiling before using, for each individual horse.

A positive (typical) reaction comprises a temperature, spot, and general reactions.

The temperature reaction is manifested by the following fluctuations of the temperature curve: temperature begins to rise after 6-8 hours; after 12-15 hours it reaches its high maximum, not below 40 degrees Centigrade; is maintained at this level, with insignificant oscillations, for 6-8 hours; then begins to descend, with many cases of a mild secondary rise after 30-36 hours.

The local reaction is manifested by the appearance on the injection spot of a sharply delineated, hot, tense, and painful swelling, which grows in size for 24-36 hours. After the expiration of this time, the swelling is slowly reduced, becomes diffused and less painful. At times the swelling lingers on for 2-3 days.

The general reaction is manifested by a state of depression, unsteady gait, restless shifting from foot to foot, fibrillary muscle contraction, yawning, accelerated respiration, accelerated pulse, intensified elimination of excrement and urine, cough, wet crepitations, running nose, enlarged ~~submaxillary ganglia~~. The degree of manifestation varies individually.

The typical rise in temperature to 39.6 - 40.0 degrees Centigrade, or by 2 degrees Centigrade above mean, in the presence of the local reaction and the general reaction, is considered as a positive reaction.

When the typical temperature curve shows a rise to above 39.0 degrees Centigrade, but does not attain 39.6 degrees Centigrade, in the absence of a sharp local reaction, or in cases where the temperature rises to 40.0 degrees and higher, but with complete absence of local reaction, the reaction is considered doubtful.

A temperature rise to /only/ 39.0 degrees Centigrade is to be considered a negative reaction to the mallein injection.

Collecting and Shipping the glanders pathological substances to be tested. Bacteriological investigations call for the following:

(1) Nasal discharges, collected onto an absorbent cotton tampon, and enclosed into a test tube, or flask, with a ground glass stopper.

(2) Exudates from ulcers (in the case of skin glanders) are taken and enclosed in the same way as nasal discharges.

(3) The contents of an abscess are gathered by a hypodermic syringe and enclosed into a sterile container.

The substance used in sero-diagnostical investigations is a serum

Generally, the blood samples must be in the laboratory not later than the third day, since, beginning with the fifth day, the serums begin to disintegrate.

The test tubes should have the sequence number of the accompanying schedule, the nameplate or name of the horse, and the name of the economy to which the horse belongs, clearly indicated.

Each shipment of blood serum to the laboratory should be accompanied by a paper as follows:

Table 22

Number of Test Tube			(Blood Tests)
Tag Number of Horse			
Name of Horse			
Name of Group (malleinnic, Isolated, etc.)			
Date	Results and Dates of Test (Complement Fixation)		(Name of Economy)
Result			
Date			
Result			
Clinical History			
Sex			
Diseases gone through in last 4 months			
Date of arrival into Economy			(Date)

(4) In extreme cases, when the blood serums cannot be delivered to the laboratory in time, they may be preserved artificially.

Serum Preservation. To preserve the serum, it is necessary to have: two pipettes of 5 cubic centimeter capacity each; 2 one cubic centimeter pipettes; a phenolized physiological solution of salt (0.85 percent of sodium chloride with 5 percent crystalline phenol); and a physiological

prepared from the blood of the horse.

The following instruments are used: a hollow needle, sterile test tubes, or flasks (the plug for the test tubes must be made of rubber, cork, in emergencies absorbent cotton will do).

(1) Sterilization of the needle: the blood-drawing needles are to be boiled in clear water for 5 minutes before each blood taking. It is permissible to add to the water phenol up to 1 percent. It is not permissible to sterilize the needles in soda solution, or to disinfect them in solutions containing soap and formalin. Mere disinfection of needles, without boiling is not permissible.

(2) The blood is taken as follows:

At a line where the upper third of the horse's neck begins, in the area of the jugular vein, the hair is shorn clean, and the area is disinfected with a 5 percent water solution of phenol. The jugular vein is then pressed in by the left thumb of the veterinarian (if the blood is taken from the left vein), and the needle injected on a slant (the angle to be about 30 degrees) in an upward direction, and 10 cubic centimeters of blood taken.

Care must be taken that the blood runs into the test tube in a stream, along the wall of the tube. Blood taken in drops becomes hemolyzed, and frequently gives wrong results in subsequent testing.

In the summer, the test tubes containing the serum are to be kept in a cool place, and in the winter near an oven (30-37 degrees Centigrade) for one hour, and then shifted to a cool place, for better settling of the serum.

The blood should be taken from the horses in the morning, before feeding.

The serum is to be shipped to the laboratory the same day the blood is taken, and, at any rate, not later than 24 hours after the first sample was taken.

solution of salt (1 liter of distilled water and 8.5 liters of sodium chloride).

The preservation is accomplished as follows: 4.5 cubic centimeters of the blood serum is pipetted, and poured into a sterile test tube. Then, drop by drop, with a jarring motion, is added 0.5 cubic centimeters of the phenolized physiological solution.

The pipette is washed through by repeated filling and forcing out of the physiological solution, and is then dried in a vertical position on filter paper. While it is drying, another pipette is used. The phenolized serums are poured over and soldered into Pasteur pipettes, in quantities of 2-3 cubic centimeters, or are poured off into small flasks, and sent to the laboratory.

Precision in measuring and cleanliness are the prerequisites of good results. The serums must be transparent, of yellowish color, and free of hemolysis.

In the absence of pipettes, it is possible to accomplish the preservation of the serum as follows: the serum is poured off into a test tube or flask in the amount of 3.5 cubic centimeters, and for each cubic centimeter of serum, 2 drops of a 5 percent phenolized physiologic solution are added with an eye dropper. Only serums showing hardly perceptible cloudiness after phenolization, are to be shipped to the laboratory. All the serums showing perceptible cloudiness, particularly if accompanied by hemolysis, are to be re-phenolized.

The test tubes are to be packed in a vertical position, and so transported. They must be protected from freezing in the winter.

For histological tests, all the parts of organs and lymphatic nodes that underwent transformation [under the impact of glanders], are to be sent to the laboratory.

In view of the series of infections of non-glanderous origin, that manifest themselves in the form of nodular lesions, it is necessary to send samples of several pieces of each lesion, encountered in the body, to the laboratory.

The sections removed are not to be smaller than a nut, containing an overhang of normal tissue. The samples are packed in a 10 percent solution of commercial formalin.

CHAPTER X

GLANDERS IN HUMANS

HISTORICAL DATA

The affliction of humans with glanders is connected with glanders in horses. A man may be infected only when in attendance upon an afflicted horse.

Statistics on human glanders are very incomplete, since, due to its rare occurrence and frequently atypical course, it is diagnosed with difficulty, usually after excluding the /possible presence/ of all other diseases. As a result, the disease sometimes runs its entire course under the wrong diagnosis. As per statistical data originating in Germany, which, according to Lewis, is incomplete and scattered, the degree of propagation of glanders in humans, as compared with that in horses, is as follows:

Table 34. Propagation of Glanders in Germany

Years	Humans	Horses	Years	Humans	Horses
1902	2	284	1909	2	298
1903	1	224	1910		228
1904	1	382	1911	1	227
1905		456	1912		308
1906	1	332	1913	1	325
1907	1	400	1919	3	820
1908	3	399	1920-1922	3	1,307

Lewis is quoting from an interesting communication by Davos. On the island of Cuba glanders was unknown up to 1876. In 1876, some horses were imported into Cubas from a certain area in the United States, contaminated with epizootic glanders. As a result, 18 humans were

stricken with the plague within the next 2 years, and during the period of 1888-1893, 89 humans were stricken and died.

In Russia, as per statistics collected by Peshtich from the data of the Chief Medical Examiner's Office, the propagation of human glanders was as follows:

Table 35. Human Glanders in Prerevolutionary Russia

Years	Number of Humans Stricken				Ratio to the Unit of Morbidity	
	European Russia	Asiatic Russia	Caucasus	Total	Humans	Horses
1902	156	2	8	166	1.00	1.00
1903	189	2	4	195	1.17	1.02
1904	181		2	183	1.10	0.90
1905	154	1	2	158	0.95	0.75
1906	167	1	3	171	1.03	0.97

Note The ratio is established as follows: The total number of horses stricken in 1902 is divided by the number of stricken humans. The quotient is the unit of morbidity for horses, while the unit of morbidity for humans is taken as 166 (the number of humans stricken in 1902).

Most of the cases of human glanders occurred in European Russia. The ratios between the number of stricken horses and the number of stricken humans is a direct relation.

Mortality in humans attributable to glanders was 64.44 percent.

The susceptibility of humans to glanders is considered as average. The most dangerous infection is one sustained through contact with microbe cultures in the laboratory.

The infection enters mainly through skin injuries. Very dangerous are straw splinters finding their way into the human body during the scrubbing down of horses. The infection also enters through the alimentary canal and other mucous membranes.

The course of the disease in humans, as well as in animals, is acute and chronic, with the chronic being the primary form, and not the transformation of the acute stage.

The incubation period is, on the average 3-5 days, sometimes stretching to 15-20 days.

The clinical history of human glanders is as follows:

THE ACUTE FORM OF HUMAN GLANDERS

Infections through skin injuries take two typical courses: with local reaction and without local reaction.

First Course A large tumor appears at the point of infection entry, becoming a purulent non-scarring wound. The regional lymphatic glands swell, with edemas and ulcers along the lymphatic vessels.

General symptoms: intermittent fever, pain in muscles and joints, headaches, nausea, vomiting, excessive perspiration. Death follows after 2-3 weeks.

Second Course At first there are only symptoms of general intoxication, such as fever, chills, perspiration, pain in muscles and joints (similar to rheumatic pains, particularly at night), headaches, reduced vitality, intestinal manifestations similar to typhus.

After 5-6 days, inflamed red edemas, firm to the touch, appear. They look like pustules, open fast, exuding a reddish fluid, and are subsequently transformed into ulcers with undercut edges. Very frequently abscesses occur in the subcutaneous cellular tissue of the calves of the legs, without any external skin manifestations. At the beginning of the second week, the symptoms of generalized glanders appear, such as skin eruption, becoming transformed into papules, vesicles and pustules, resembling same in smallpox, but without the caving-in effect. The process also affects the nasal mucous membranes, with

ulcers forming and the voice becoming nasal. Ulcers forming in the larynx cause aphonia, ulcers in the mouth and on tonsils make swallowing difficult, with excessive flow of saliva. When the process moves on to the lungs, it induces bronchial pneumonia. The patient collapses and expires by the third or fourth week.

When a case of chronic glanders is transformed into an acute phase, death usually occurs on the third day.

THE CHRONIC FORM OF HUMAN GLANDERS

Chronic glanders also runs in 2 forms: with local lesions and without local lesions.

First Form: Disease appears in the same manner, as in the respective acute phase but has a more quiescent course. After 4-6 weeks, there is a sudden appearance of a great number of cold and painless abscesses, particularly around the joints. The abscesses are either resolved or open up, discharging a cloudy oily fluid - glanders oil. The lesions may heal, and the patient may recover. However, relapses are known to occur even after a considerable time has passed. One case was registered, where a relapse occurred after 3 years. The course of disease may drag out for 15 years, and if there is no stable improvement, the patient usually dies from emaciation, accelerated tuberculosis, or sepsis.

Second Form: After the appearance of general intoxication symptoms, such as fever, headaches, muscular pains, excessive perspiration, there is difficulty in breathing, a head cold without the typical glanders discharge, frequent coughing, pain in the sides of body, and considerable loss of weight. Soundings and percussion tests either produce no results, or indicate the presence of catharrhal bronchial pneumonia. There are periods of improvement. When these are

stable and enduring, the patient recovers. If the reverse is true, the process becomes exacerbated, with death following in rapid succession.

In the case of acute human glanders, the prognosis is completely [illegible], while in chronic human glanders, according to Bollinger, there may be from 20 to 50 percent of recoveries.

Diagnostics in human glanders follows the same procedure as in animals.

When there are secretions, it is best to use the bacteriological method with the experimental contamination of a guinea pig and a cat.

In case of the chronic stage, or an acute case lingering for 2 weeks, the titration standard of the blood serum in the CFT reaches 0.01. The reaction to the mallein test is best to follow by applying the [illegible] procedure.

PROPHYLACTIC MEASURES AGAINST THE

CONTAMINATION OF HUMANS

A horse is to be approached from the side, the attendant to be dressed in coveralls, boots, and rubber gloves. To avoid exposure to a snort, when the horse's mouth is to be opened, its tongue should be pulled sideways. Black face masks are not to be used in dealing with a horse, since it will easily frighten the animal. It is convenient to use a celluloid or de-emulsified photo-film sheet, size 24 x 30. The film is put over the face in such a manner that its top edge is firmly held by the attendant's headgear, or by a system of strings. When pathological secretions of the horse land on the coveralls, the latter is to be immediately removed and immersed in a 3-5 percent solution of phenol, lysol, or creolin. Boots are to be thoroughly wiped with a 5 percent solution of creolin, gloves to be washed in a 5 percent solution of creolin and kept in a similar solution for 1 hour. All working clothes, after the examination of afflicted horses, are to be disinfected by immersion into a 3 percent solution of phenol, lysol, or

creolin for 30 minutes, after which it is to be boiled with lye. The mask, film and reflector to be thoroughly wiped with similar disinfectant solutions. When pathological substances from the horse find their way onto the skin of the hands or face, it is imperative to wash hands and face with above disinfectants, or with a solution of mercuric chloride, 1:1000 or 1:500. At the beginning of the examination, particularly when hands are not protected by gloves, the finger tips and the entire nail areas are to be covered with a tincture of iodine. In case of injuries or breaks in the exposed areas of skin, [attendants and veterinarians are to stay away from any contact with afflicted horses]. All articles, even if not mentioned, but exposed to contamination during the examination, are also to be thoroughly disinfected.

The most dangerous infections may take place within the laboratory. The basic prophylactic measures against them are as follows:

1. Always work together with a qualified assistant.

2. The nerves to be relaxed.

3. The job in hand to be reviewed in one's mind, down to minutest details. Accordingly, a list of all the necessary articles and objects, including such minutia as wax pencils, test tube racks, dishes, etc., must be made, as well as a list of all instruments and protective devices against the possible spattering of pathogenic substances.

4. Pathogenic substances are under no circumstances to be drawn by mouth into the Pasteur and measuring pipettes. All pipettes to have rubber suction balls. All liquids to be dipped out with rubber syringes. Most of the infections on record fall into these grooves.

5. For the duration of the job in hand to keep away from outside irritations that may come in the form of visits from third parties. At any rate, when third parties are present, no attention whatsoever shall be paid to them.

6. A solution of mercuric chloride 1:1000 for disinfecting, and a physiological solution for the washing of eyes, nose, and mouth, always to be on hand.

7. If conditions call for it, surgical rubber gloves are to be worn; under usual circumstances, covering the finger tips and nail areas with tincture of iodine is adequate.

8. Nose and mouth to be protected by respirator, or gauze-bandage; eyes to be protected by goggles.

9. Work with microbe cultures, and bacteriological diagnostics in general, are allowed in the well equipped laboratories only, under respective license and control of the Veterinarian Administration of the People's Commissariat of Health and the State Control Institute.